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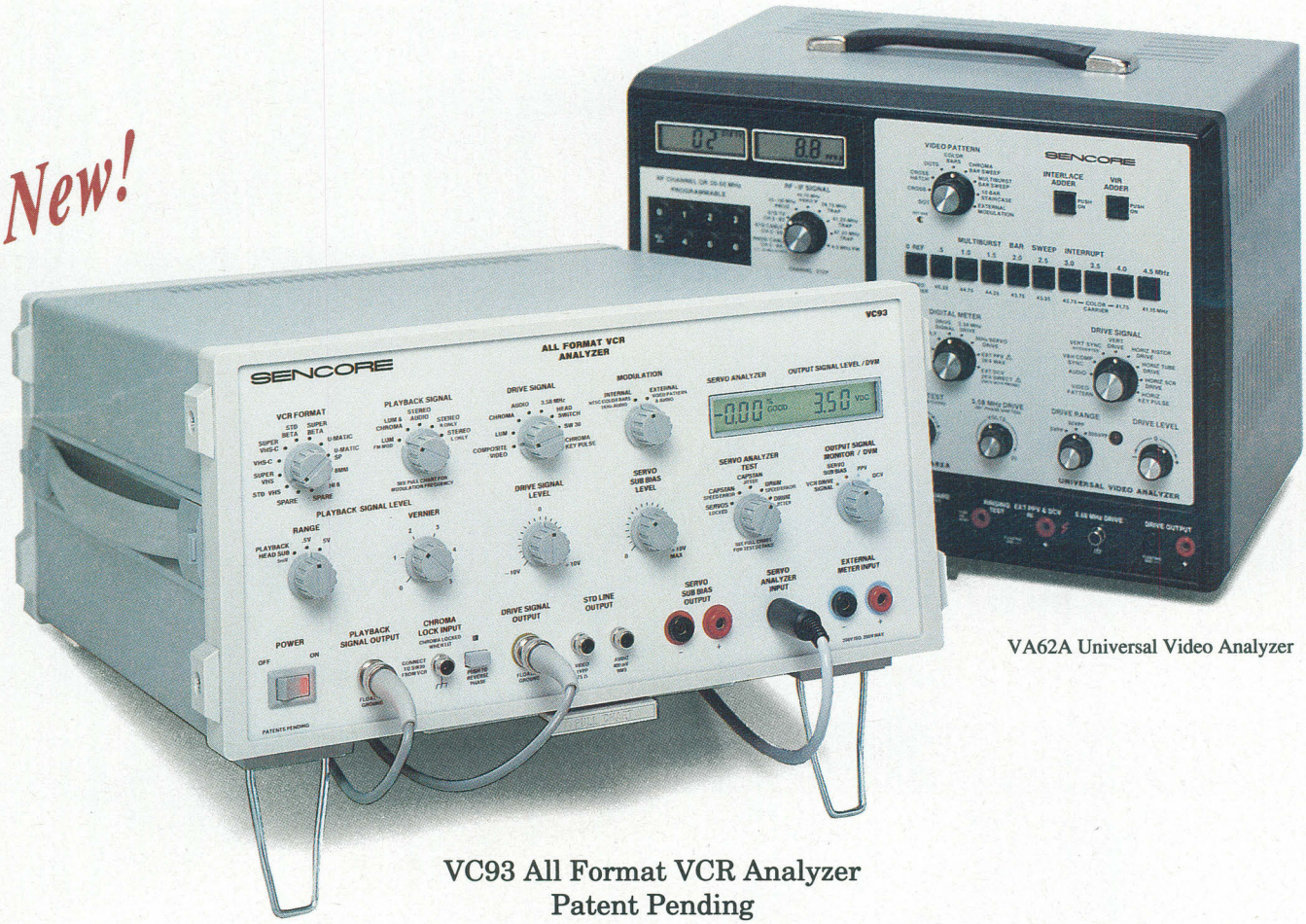

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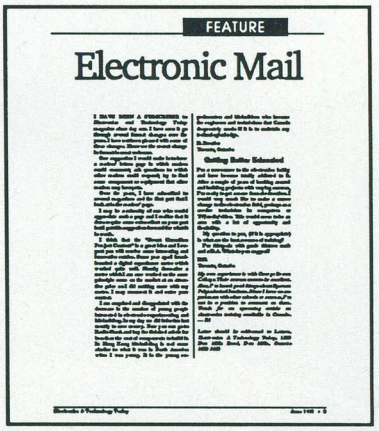
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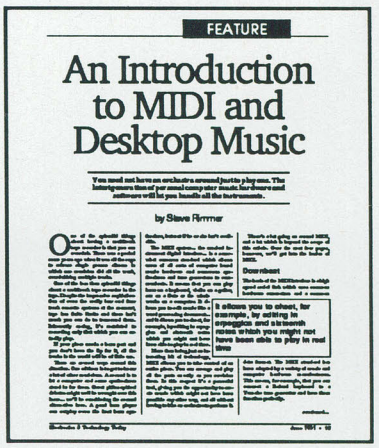
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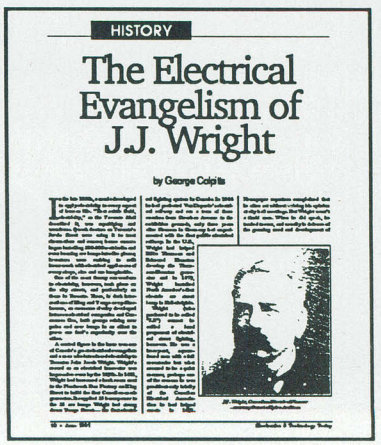
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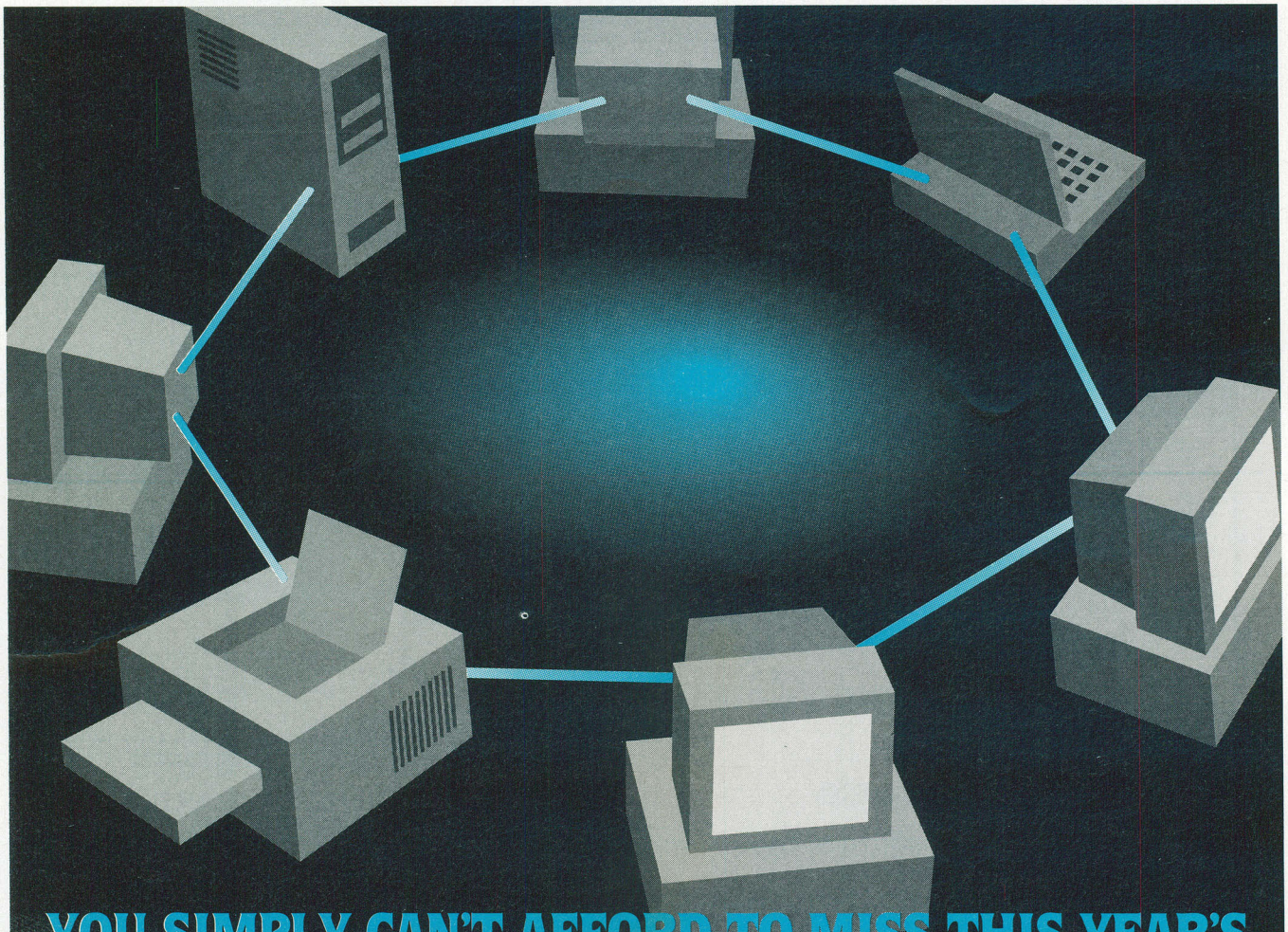

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Editorial

This month we are featuring MIDI. MIDI stands for Musical Instrument Digital Interface and it is a really "neat" way of making music. What can be done using this standard is mind-boggling. The danger (if you can call it that) is that technical ability may be substituted for talent.

Also, we are starting a new column — **Letters!** This can be an excellent forum for all the readers to communicate, not only with *Electronics and Technology Today*, but with each other. So, please send in your letters, comments or questions and I'll print as many as possible and we'll get some great communication going. Looking forward to hearing from you.

Chuck Ander
Editor

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FEATURE

Electronic Mail

I HAVE BEEN A SUBSCRIBER to *Electronics and Technology Today* magazine since day one. I have seen it go through several format changes over the years. I have not been pleased with some of these changes. However the recent change in format is most welcome.

One suggestion I would make is to have a readers' letters page in which readers could comment; ask questions to which other readers could respond; try to find some component or equipment that other readers may have; etc.

Over the years, I have subscribed to several magazines and the first part that I look at is the readers' page.

I may be a minority of one who would appreciate such a page and I realize that it does require some extra effort on your part but I put this suggestion forward for what it is worth.

I think that the **"Great Canadian Project Contest"** is a great idea and I expect you will receive some interesting and innovative entries. Some year ago I breadboarded a digital capacitance meter which worked quite well. Shortly thereafter a meter which I am sure worked on the same principle came on the market at an attractive price so I did nothing more with my meter. I may resurrect it and enter your contest.

I am surprised and disappointed with the decrease in the number of young people interested in electronic experimenting and kit-building. In my day we did it for fun but mostly to save money. Now you can go to Radio Shack and buy the finished article for less than the cost of components to build it. In Hong Kong kit-building is real craze similar to what it was in North America when I was young. It is the young experimenters and kit-builders who become the engineers and technicians that Canada desperately needs if it is to maintain any technological edge.

B. Prentice
Toronto, Ontario

Getting Better Educated

I'm a newcomer to the electronics hobby and have become totally addicted to it. After a couple of years of hacking around and building projects with varying success, I'm ready to get a more formal education. I would very much like to make a career change to the electronics field, perhaps as a service technician in computers or TV/audio/video. This would seem to be an area with a lot of opportunity and flexibility.

My question to you, (if it is appropriate) is what are the best avenues of training?

I'm thirty-six with grade thirteen math and a B.A. What do you suggest?

B.B.
Toronto, Ontario

My own experience is with George Brown College. Their courses seem to be excellent. Also, I've heard good things about Ryerson Polytechnical Institute. Since I have no experiences with other schools or courses, I'm not in a position to comment on them. Watch for an upcoming article on electronics training available in Canada. — Ed.

Letter should be addressed to Letters, Electronics & Technology Today, 1300 Don Mills Road, Don Mills, Ontario M3B 3M8 ❐

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New Products

Commodore Launches New Consumer Electronics Category: CDTV First Interactive Multimedia Player

With the introduction of its CDTV Interactive Multimedia player, Commodore Business Machines launches the first consumer interactive multimedia products and an entirely new consumer electronics product category.

CDTV is the first of a new generation of consumer electronics products to combine audio, video, graphics and text in a revolutionary product that will change the way consumers are educated, informed and entertained.

The CDTV player is a sleek, black unit similar in appearance to a conventional VCR or CD-Audio player with interactive multimedia capabilities. Titles are accessed by your television through a simple hand-held remote control and offer an unparalleled audio and video experience.

"The introduction of CDTV Interactive Multimedia signals the next phase in the evolution of consumer electronics," said Tom Shepherd, director of marketing of Commodore Business Machines. "We believe that the merging of consumer electronics and advanced microchip technology will be the major consumer electronics product trend of this decade," continued Shepherd.

Commodore has made a substantial commitment to the CDTV player, and has engineered the product to meet the long-term needs of its users. The open architecture design of the CDTV player enables easy modification and upgrades. For example, Commodore plans to make the CDTV player compatible with the Moving Picture Expert Group (MPEG) full-screen, full-motion standard, once that standard is established.

The player also supports all CD-Audio discs and the music industry's new formats, CD+Graphics (CD+G) and CD-MIDI titles.

In order to ensure that the CDTV player be a truly international product, the player is compatible with all television monitor standards, including NTSC, Super-VIDEO, and Europe's PAL, as well as all standard RGB monitors.

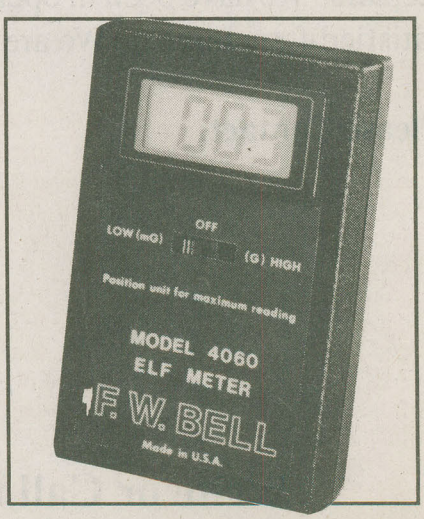
"The real point of difference between CDTV and conventional formats is the way CDTV Interactive Multimedia engages the user," said Shepherd. "Because using the CDTV player is so simple and applications so powerful, the end-user becomes totally involved in the title. CDTV Interactive Multimedia transforms television from a passive medium to an active medium."

For more information contact: Tom Shepherd, Director of Marketing, Commodore, (416) 499-4292.

Circle No. 13 on Reader Service Card

BSC Electronics Ltd. to Distribute New ELF Meter

A compact, consumer-oriented electronic meter called the "4060 ELF Meter," developed to detect magnetic field radiation emitted by all 60Hz electrical sources, is now being distributed by BCS Electronics Ltd. of Downsview Ontario. Generated by scores of electrical devices including: power transmission lines, computers, electric blankets, televisions and household appliances, magnetic fields have become a growing concern among the public, industry and the government for their suspected cause of such health problems as cancer, birth defects and brain tumours. Because the new meter measures the amount of magnetic radiation emitted by a source, it allows the operator the ability to determine



whether appropriate action to avoid overexposure to the fields is necessary. The meter sells for under $180 and is manufactured by F.W. Bell, Inc. of Orlando, Florida, a pioneer in the development of magnetic field measuring devices.

BCS Electronics has been distributing high quality general purpose electronic test equipment for nearly 19 years.

For more information contact: BCS Electronics Ltd., 980 Alness St., Unit 7, Downsview, Ontario M3J 2S2 Tel: (416) 661-5585 Fax: (416) 661-5589.

Circle No. 14 on Reader Service Card

World's First Digital Optical Link Consumer-Use Component Stereo System

Listeners can look forward to setting up new stereo systems with fewer hassles from unsightly, troublesome wires — but with uncompromised sound quality — thanks to a new product development by Matsushita Electric Industrial Co., Ltd., of Osaka, Japan.

Using technology known as OPT-DIGITAL (optical digital), Matsushita engineers developed the Panasonic Digital Optical Link Component Stereo

System, SC-FX1, the world's first consumer stereo to use digital signals to optically link a music source unit with an amplifier. This new system provides users with greater flexibility in the placement of the amplifier unit and speakers.

Current optical link systems transmit sound in analog format, leaving signals open to distortion during transmission (S/N ratio: 50-60 dB). With Matsushita's new OPT-DIGITAL technology, signal purity is preserved (S/N ratio: 90 dB) by digitally encoding sound prior to its optical transfer.

Music from the SC-FX1 main unit — which features a stylish "lap-top" design complete with fold-up display, CD player, double deck and tuner — is processed with an A/D converter connected to a transmitter. Using infra-red rays, digitally-encoded sound is optically sent to a receiver which can be located up to seven metres away. The digital information is then converted back to analog form and fed into the amplifier. The two speakers are connected to the amplifier with 2.4m cables.

The SC-FX1 System went on sale in Japan on March 1, 1991. Initial monthly production will be 3000 units. There are plans to export a digital optical link stereo system when export model specifications have been confirmed.

For more information contact: Matsushita Electric of Canada, Robert Donnelly, Tel: (416) 238-2224.

Circle No. 15 on Reader Service Card

Tracking Motor Vehicles Using Broadcasts

Peter Duffett-Smith, a Cambridge University physicist, is seen testing his new radio navigation and vehicle tracking system inside a mobile laboratory in Cambridge, eastern England. The screen displays the present position of the vehicle as it travels down a road or highway.

This new method, called CURSOR, uses broadcasts from any existing radio and television stations instead of the costly network of dedicated ground-based or satellite radio transmitters involved in other systems.

As a result it is much cheaper, and can be used immediately anywhere in the developed world. Yet it can pinpoint the position of a vehicle, ship, aircraft or even a person on foot with a remarkable degree of precision. The demonstrator unit uses local AM broadcast transmitters to indicate the position of a vehicle to an accuracy within five metres as it travels at about 110 km/hour.

The system's high accuracy is largely due to the very large number of existing relatively high-frequency transmitters from which to choose in many parts of the world. Most dedicated-beacon systems use low frequencies for long-range stability, but higher frequencies offer greater measuring accuracy.

At least three transmitters are needed, but many more can be used, with the advantage of limiting the effect of signal distortion due to atmospheric disturbances or reflections in built-up areas. The initial demonstrator uses eight signals simultaneously. By using the closest broadcast transmitters, errors due to signal propagation effects can be further reduced.

A major advantage of the system is the simplicity and relatively low cast of the equipment involved. A commercial unit would be about the size of a typical car radio.

For more information contact: Peter Duffett-Smith, Department of Physics, Cambridge University, Cavendish Laboratory, Madingley Road, Cambridge, England CB3 OHE. Tel: 0223 337477 Fax: 0223 63263. ❐

Circle No. 16 on Reader Service Card

HISTORY

The Electrical Evangelism of J.J. Wright

by George Colpitts

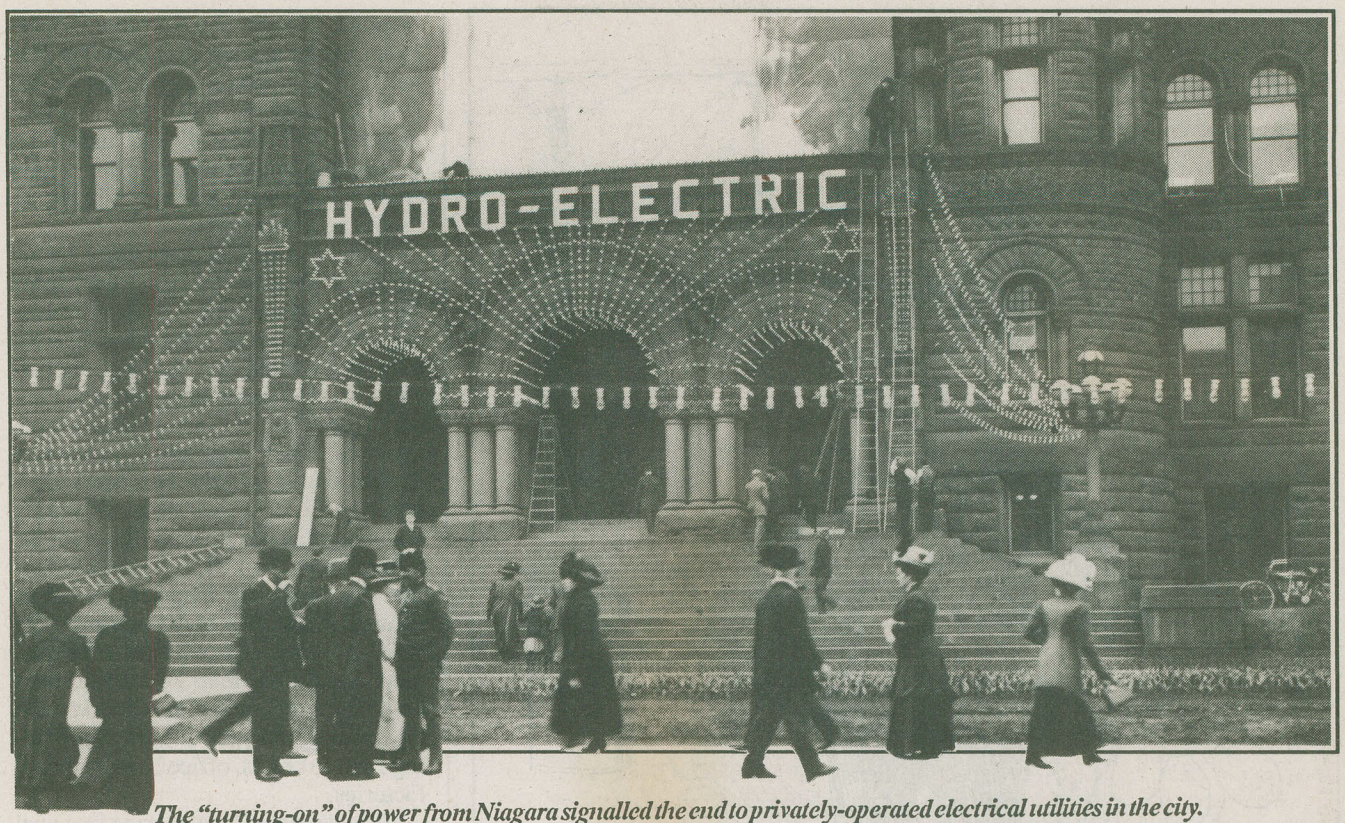
In the late 1800s, a mania developed to apply electricity to every aspect of human life. "That subtle fluid, electricity," as the *Toronto Mail* described it, was mystifying and wondrous. Quack doctors on Toronto's Jarvis Street were using it to treat rheumatism and cancer; house owners began installing 200-300 watt bulbs and even buzzing arc lamps into fire places; inventors were rushing to refit housework with electrical appliances of every shape, size and use imaginable.

One of the most thorny conversions to electricity, however, took place on the city streets, and particularly on those in Toronto. There, in dark intersections of King and Yonge or up Sherbourne, an awesome rivalry developed between electrical companies and Consumers Gas, both groups raising new poles and new lamps in an effort to prove one fuel's superiority over the other.

A central figure in the issue was one of Canada's great electrical evangelists and a man who introduced electricity to Toronto: John Jacob Wright. Wright's record as an electrical innovator was impressive even by the 1890s. In 1881, Wright had borrowed a back room next to the Firstbrook Box Factory on King Street to build the first Canadian-made generator. It supplied 25 horsepower to the 25 arc lamps Wright had strung down Yonge Street — the first electrical lighting system in Canada. In 1884 he had perfected Van Depoele's electrical railway and ran a tram of three coaches from Strachan Avenue to the exhibition grounds, only three years after Siemens in Germany had experimented with the first public electrical railway. In the U.S., Wright had helped Elihu Thomson and Edmund Houston develop the Thomson-Houston generator and in 1879, Wright installed North America's first electric arc street lamp in Philadelphia.

Wright (who preferred to be called "J.J.") cannot be called a loud proponent of electrical street lighting, however. He was a heavy-set, square-faced man with a full moustache but what seemed to be a quiet manner, perhaps one of the reasons he was president only briefly of the Canadian Electrical Association he had helped create in 1891. Newspaper reporters complained that he often sat without voicing his opinion at city hall meetings. But Wright wasn't a timid man. When he did speak, he tended to roar, and usually in defence of the growing need and development of

J.J. Wright, Canadian Electrical Pioneer
–courtesy Ontario Hydro Archives



The "turning-on" of power from Niagara signalled the end to privately-operated electrical utilities in the city.

electrical applications both in Toronto and the rest of Canada.

Wright's most comfortable medium was when he was experimenting or designing the massive electrical system he helped pioneer in Toronto. His son Walter F. Wright, shed some light on that tinkering spirit when he described his father and uncle pulling an old steam engine down to the waterfront, and bolting it onto a boat to create the first steam yacht on Toronto Bay. *The Electra* was the same yacht on which Wright entertained Electrical Association members. He loved "open air and country," and "speeding across the bounding waves" of the lake.

Born and classically educated in England, Wright seemed to have difficulty finding his life's direction when he arrived in Canada. He picked up jobs as a millwright and later as a proofreader at the *Globe*, finally drifting back and forth between the U.S. and Toronto until he began his work in electricity. After that, and when he wasn't boating, Wright devoted almost his entire life and aspirations to the job of lighting Toronto — and Canada — with electricity.

Toronto was typical of most Canadian cities of that time period. Charles Dickens in the 1842 had described the city as "... full of life, motion, business and improvements. The streets are well-paved and lighted with gas."

But those gas-lit streets were shadowy, dark and dangerous to walk along at night. After dusk, Toronto's streets were given over to fighting, gambling, prostitution — general ly doused in sin. The *Toronto News* in 1885 published "thrilling sketches" of Toronto's seedy nightlife, a reporter adding "the long row of gas-lamps on the side streets 'pale their ineffectual fires'...." In Montreal, William H. Atherton said "Darkness is the friend of vice," in his campaign for better lighting. Back in Toronto, the *Mail* complained about gas lighting shedding its "yellow jaundiced-looking light." It is quite possible that Wright, a methodist who played organ on Sunday mornings, was wanting to

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Advertisement from Toronto, 1870s, showing competition among fuel and light companies – Metropolitan Toronto Reference Library (Baldwin Room)

J.J. Wright, as depicted in a popular book on Toronto Public figures

reform the dark city streets with his arc lighting.

Electricity might have been a novel approach to lighting dark streets, but it wasn't clearly a superior alternative at the time Wright was hooking up lights to Eaton's department store, Robert Simpson's store, and McConkey's restaurant in his original 1881 experiment.

One arc, for instance, couldn't replace five gas lights strung down a street (remember that illumination decreases in proportion to the square of the distance from the source). Often fewer of the more expensive arc lamps were erected creating dramatically well-lit areas immediately around them, but leaving dark and shadowy areas between each light.

Described by the *Mail* as "a light rivalling almost that of the sun in brilliancy," the arc lamp's brilliance also had unhealthy side effects. The light was dangerous to look at directly and quite frankly, an Edison pamphlet complained its brilliance hurt the eyes.

Furthermore, the arc light gained a significant degree of unreliability from its very design. Two carbon rods were placed at a specific distance from each other. Light was created when electricity formed an arc from one rod to the other, causing carbon particles detached from the rods to glow intensely. The deteriorating carbons, however, had to be moved together as they burned. In early models, an elaborate clockwork mechanism moved them back together in time periods. Later, Brush arc lamps featured a closed-loop, or self-regulating design which sensed when an arc was lengthening between carbons. Hence, the increased resistance in the system regulated the distance. The constant regulation in the system caused flickering, various degrees of brilliance, and didn't alleviate the maddening buzzing sound from what were termed simply as "those sputtering arcs."

There was one other problem facing Wright's dreams for electrical street lighting. Competition was quickly arising from dozens of companies offering everything from arc lighting alternatives, to new generators. Wright himself found Elmer Sperry [See March Issue of *Electronics and Technology Today*] setting up a similar system a few blocks away from his own. Electricity and its appliances were spilling over the border from the U.S. in awesome surges. By 1880, for instance, 72 urban centres in Canada had electricity. By 1890, 167 did, and one business directory listed more than 70 electric light companies operating in Canada with hundreds of independent plants providing light to hotels, office buildings, and factories.

Wright reacted by gathering financial backing and creating the Toronto Electric Light Company which eventually took precedence over all others before public utilities were created. The principal figures in the new company, Frederic Nicholls, Sir Henry M. Pellatt (Casa Loma's somewhat eccentric creator) and William MacKenzie soon became known as the "syndicate," wielding enormous amounts of power as their company soon controlled large portions of the city's interior and exterior lighting and transportation monopolies.

As manager, however, Wright was able to continue his tinkering, experimenting and design of the electrical system. When the Toronto Electric Light Company was created, City Council allowed it to erect 25 lights in the downtown core on Yonge Street and Queen. Wright was using the Hochhausen patents, known as the Excelsior system which had its headquarters in New York city. Another company was allowed the same privilege, using the Van Depoele system, so that city council could choose between alternatives.

Wright wasn't enthusiastic about using American electrical goods. In Oc-

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(Please allow 2-4 weeks delivery)

J.J. Wright perfected the use of this electric railway system — one of the first in the world.

tober, 1893, he said "If we are to adopt nothing but American ideas or Chinese ideas or antediluvian ideas, we might as well cease to exist and let other people do our thinking for us." Later, he urged the Canadian Electrical Association to adopt a Canadian standard of illuminating power for arc lamps instead of an imported one. The trend in Canada, however, remained to import American goods or buy their patents.

On May 16, 1884, the *World*, *Globe* and *News* carried the reports of Toronto's first experience with arc lighting as both companies switched on their rival systems. Both the manufacturers had come to Toronto to help install their systems.

"The gas street lamp must go," the *World* began its story. "The new illuminant, electricity, has come to take its place." The reporter wrote he "was able to read fine print 60 yards from one of the lamps."

Wright remained in control of the company and later described power management as a job requiring hard work at night, filled with tension and having a degree of danger. It was also "hot and dirty" he said to young men seeking employment in his company.

One of Wright's first achievements was building a power station on Scott St. and the Esplanade. There, in a location close to the water and coal supply, Wright designed the station to rival even Jules Verne's descriptions of Nimo's submarine. Containing an engine and dynamo rooms, the power station had a board room and library; a spiral staircase led to a tower laboratory and instruments room. The interior was finished in polished oak — hardly what one would expect in a power station. Later he seemed to temper his imagination when he designed another arc-lighting station, stressing its functionality. "There will not be a piece of wood as large as a lead pencil used in the construction of the building," he said, describing its fireproof features.

As manager, Wright oversaw the design of a system to synchronize clocks in all stations, an important function because power was literally cut off at dawn and turned on at dusk. As the company took over incandescent and interior lighting functions, electrical use wasn't metered. Rather, it charged per light, and supplied parts that would break down faster if overused, a subtle but effective way of limiting its consumers' use of energy. Later, Wright was active through the Canadian Electrical Association, directing metering standards which the government was imposing on private companies.

The growing efficiency of the Toronto Electric Company's system was one of its greatest features. It could be maintained, for instance, with only a few unskilled labourers, enough for one writer to *Canadian Electrical News* to say "I am entirely disgusted with the electrical business...." He said a station manager could be hired for $35 - 40 a month: "The ability to shovel coal, climb a pole, put a pair of carbons in an arc lamp and sling oil around the power house are the essential requirements."

But there was a period of experimentation as the system found its place among the already crowded telegraph and telephone poles stretching across streets and intersection. The *News* reported in 1896 that one of the TELC's linemen, who was able to climb poles with only one arm, dropped a cross arm he was installing onto the head of passerby on Yonge and King. The man's hat was driven "down upon his shoulder and entirely [obscured] his face." Miraculously, the man was not hurt and after the lineman helped pull off the hat,

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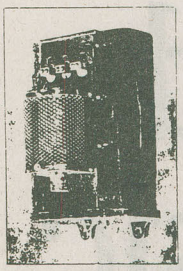
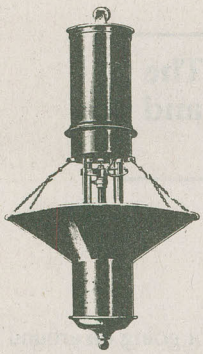


When ordering, the periodicity of the Circuit should be given. In certain instances a Choking Coil must also be used to ensure accurate adjustment of voltage. Add Codeword "*Accuracy*," and extra price, according to list, page 370.

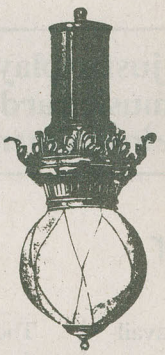
Reduction in Volts	10 to 15 AMPÈRES.			20 to 25 AMPÈRES.		
	Catalogue No.	Codeword.	Price	Catalogue No.	Codeword.	Price.
			£ s. d.			£ s. d.
100 to 35	L.1240	*Accurse*	4 10 0	L.1244	*Achieve*	5 0 0
100 to 70	L.1241	*Accuse*	4 10 0	L.1245	*Aching*	5 0 0
200 to 35	L.1242	*Accustom*	5 0 0	L.1246	*Acidity*	6 0 0
200 to 70	L.1243	*Acetify*	5 10 0	L.1247	*Acidulate*	7 12 0

Projection, 8¾". Width, 8¾".

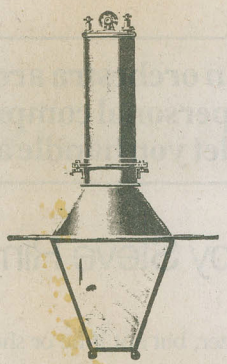
SPECIAL COVERS FOR ARC LAMPS.



INVERTED HOOD.



ORNAMENTAL COVER. BRONZED AND RELIEVED.



FACTORY LANTERN.

For Prices and Codewords of these Covers fitted to "Aston" Open Type Lamps, types K or L, see pages 364 and 365. The illustrations are substantially correct, but the details are liable to alteration as improvements are made.

Types of arc light designs, from 1890s catalogue: The CBC Broadcast Museum

and bought him a new one at a nearby store, no charges were laid. That wasn't the case, however, for a woman in 1894 who was suing the company after she had walked into a power line dangling in the street.

Certainly, Consumers Gas, the company holding the street lighting contract in the late 1800s was concerned over Wright and his electrical company. W.H. Pearson, the company's manager kept a careful newspaper clipping file on items related to gas or electric street lighting. That file is still held in the gas company's archives and was supplied for this article.

The company reacted to the threat of electricity by slashing gas rates, providing better burners and a more pure gas. By the time electricity supplanted gas, Inspector James Williams had cut down his staff to 27 lamplighters who had to maintain, light and replace 2,644 gas street lights—almost one man for every 100 lights. (Their duties included making careful note of the exact locations of the electric lights that were out, to prove their unreliability.)

Wright was not impressed, however, and he wrote to the *World* in October 1890 to say that the fight for or against electrical lighting was between the city aldermen, representing a public wanting electricity, and the gas company which wanted to maintain its monopoly. He compared the advent of electricity as the beginning of a more democratic, fair system, where competing electrical systems would generally lower the already cheaper fuel. In fact, Wright was exaggerating about electricity being cheaper, and greatly offended Pearson who retaliated in the next day's news to say Wright's letter was insulting and unwarranted. "I can only conclude that he has lost his temper, and with it his head and good breeding."

Electrical lighting was gradually chosen by city council. In 1883 it replaced 300 of the gas company's lights for 100 electrical lamps along Carleton, College and Sherbourne Street. By 1890, the city asked for 2,300 gas lights to be taken off the streets and by 1901, Consumers Gas lost the street lighting contract altogether.

But the dominance of private, monopoly fuel companies, however, was already being challenged, and the TELC had only a few years to enjoy its monopoly before the 1905 creation of public-owned utility. The impetus for Ontario Hydro and Toronto Hydro was the need to transport electricity from Niagara Falls, an undertaking no privately-owned company could really contemplate. Edison once said "...one of these days we will chain all that — the Falls of Niagara as well as the winds — and that will be the millennium of electricity." As early as 1896, the mayor of Buffalo threw a switch to energize the city with energy from the falls.

Wright himself, repeatedly testified to the provincial government that his company had looked into the same type of Niagara transmission and found there was too many problems. His company was simply too small to absorb the capital costs required. By 1911, electricity was finally poured from the falls to Toronto through the public utility, celebrated in a massive parade by night to the old city hall where a picture of the falls was lit up and water cascaded over the mural (and onto front-row spectators).

Although Wright and the TELC continued competing with Toronto Hydro, often providing better service than the new company, the days of private electrical companies were coming to a close.

Wright's son said that despite his expertise, J.J. opted not to consult for large sums of money. "My father was never interested in money," he said. When Fred Thomson, brother of Elihu Thomson wanted his father's opinion

see **Wright**, *page 19*

FEATURE

An Introduction to MIDI and Desktop Music

You need not have an orchestra around just to play one. The latest generation of personal computer music hardware and software will let you handle all the instruments.

by Steve Rimmer

One of the splendid things about having a multitrack tape recorder is that you can overdub. There was a period some years ago when it was all the rage to release single person albums in which one musician did all the work, overdubbing multiple tracks.

One of the less than splendid things about a multitrack tape recorder is the tape. Despite the impressive sophistication of even the really low end four track cassette systems at the moment, tape has finite limits and there isn't much you can do to transcend them. Inherently analog, it's restricted to recording only that which you can actually play.

If your piece needs a horn part and you don't have the lip for it, all the tracks in the world will be of little use.

There are several ways around this situation. One of them is to get to know a lot of other musicians. A second is to let a computer and some synthesizers stand in for them. Great philosophical debates might well be wrought over this issue... we'll be considering the second alternative here. A good horn player can outplay even the best horn synthesizer, but not if he or she isn't available.

The MIDI system... the musical instrument digital interface... is a somewhat common standard which allows users of all sorts of computer based music hardware and numerous synthesizers and tone generators to communicate. It means that you can play horn on a keyboard, violin on a guitar, sax on a flute or the whole works on a computer. It allows you to edit music like a word processing document... and it allows you to cheat, for example, by editing in arpeggios and sixteenth notes which you might not have been able to play in real time.

More than being just an interesting bit of technology, MIDI allows you to take control of an entire piece. You can arrange and play all the parts exactly as you envision them. In this respect it's a powerful tool, giving you the opportunity to create music which might not have been possible any other way, and all without having to hire an orchestra to perform it.

There's a lot going on around MIDI, and a lot which is beyond the scope of this article. Over the next few pages, however, we'll get into the basics of MIDI.

Downbeat

The basis of the MIDI interface is a high speed serial link which uses common hardware connectors and a common data format. The MIDI standard has been adopted by a variety of music and computer hardware manufacturers. This means, for example, that you can connect a Roland keyboard to a Yamaha tone generator and have them function perfectly.

It allows you to cheat, for example, by editing in arpeggios and sixteenth notes which you might not have been able to play in real time

continued...

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Also see page 22

Music can be thought of in digital terms as being the fusion of two types of data. Tone data is the information which makes a brass voice sound different than a string voice. Note data is the information which results from pressing the keys on a keyboard to play music. In isolation, the second sort of data is independent of the first. You can... at least in theory... play the same notes through different voices to have a piece play as if by different instruments. One of the things which most MIDI users discover early on is that you can play something in its usual voice... Pachelbel's Canon played in a string or organ voice is a popular victim of this experiment... and then have your computer play it back through a wholly different voice. The Canon played on saxophones, for example, is unusual. Classical performers might find other words to describe it played this way.

If you play a piece on a MIDI instrument, the note data which results from your playing can be sent through the MIDI interface and recorded as digital information on, for example, a computer. It can thereafter be stored on disk and replayed precisely as you played it a week later... through a different instrument if you like.

It can also be edited. Score and sequence editing software such as Cakewalk or Ballade allows you to change a few notes, add in whole passages and fix your mistakes. It can perform such things as transposition and quantization, the latter being a sort of "snap" function which will adjust notes played slightly off beat.

A MIDI synthesizer which receives MIDI note information need not know where the information is coming from. As such, you can play music into a MIDI system through whatever instrument suits your fingers. Among the possibilities are a traditional synthesizer keyboard, a MIDI guitar or a flute or other wind instrument fitted with a pitch to MIDI converter such as the Roland CP-40... you can also sing into one of these. Finally, you can create music from scratch in a computer based score editing program and never actually play anything.

It's probably worth mentioning that unlike MIDI note data, voice information tends to be manufacturer specific. It can be sent over a MIDI interface, but will only be of use to synthesizers similar to the one which sent it. Each of the major MIDI synthesizer manufacturers has a proprietary synthesis system, and these are disparate enough to make their voice definition data incompatible.

On Track

It's probably easiest to think of a complex MIDI system as being composed of two sorts of devices, that is, ones which send MIDI note data and ones which receive it. MIDI senders include keyboards, MIDI guitars and computers. MIDI receivers include tone generators and computers. In many cases the same box may encompass both a sender and a receiver. For example, a traditional keyboard synthesizer with a MIDI interface can both generate note information and play notes independently of its keyboard if note information is sent to it from another source. To keep things clearer, you might want to think of such an instrument as being two distinct boxes in one.

A computer typically doesn't play the notes sent to it, but rather records them. It serves as a MIDI receiver none the less. There are, in fact, quite a few MIDI cards for personal computers which serve as both MIDI interfaces and tone generators. As such, the role of a personal computer in a MIDI system is growing.

In most cases, you'll only need one or perhaps two keyboards, even though your pieces will typically have many more voices. The sequencing software available for computers allows you to overdub MIDI tracks just as you would tracks on a tape recorder. As such, there is a wide variety of "keyboard-less" synthesizers available especially for MIDI applications. These "tone generators" are boxes which will accept MIDI note information and play the notes in high quality voices.

We've discussed MIDI note data informally until this point. It's really the heart of what MIDI can do, and it should serve to give you a clear understanding of what you can do with this technology. A lot more than just notes can move over the cables of a MIDI system.

A typical MIDI instrument has three MIDI connectors labelled In, Out and Through. MIDI instruments can be chained together, such that all the instruments in a system appear to be on a common bus. In fact, in large MIDI systems the propagation delays through many chained instruments may present the more remote instruments with timing delay problems. In these cases, MIDI splitters or "through" boxes can serve to drive multiple instruments in parallel.

Every packet of information which is placed on the MIDI bus includes the nature of the information in the packet and a MIDI channel number. There are sixteen available channels in a MIDI system. This means that you can have sixteen voices playing different parts running through the system at one time.

Consider a simple piece... we'll further abuse Pachelbel's Canon in this instance. As it's usually played, the Canon has three violins and viola. Each of these instruments plays different notes. Allowing that the note data for the Canon is stored in a sequencing program and will be played back, you could assign each of the four tracks to a different MIDI channel number and then connect four MIDI tone generators to the bus, each set to listen to a different channel. The tone generator which was set up to listen to channel one would play the first violin part, the tone generator which was set up to listen to channel two would play the second violin part and so on.

In a real world tone generator, you might only need one actual box. The Roland MT32 tone generator, for example, has thirty-two actual voices which can be assigned any way you like over the sixteen MIDI channels. You can program the box to have two voices

available for each of the sixteen MIDI channels, or four voices for your choice of eight channels or all thirty-two voices on a single channel. There are still other permutations, of course.

Having more than one voice on a channel doesn't mean much to a piece like the Canon, in which no one instrument is called upon to play more than one note at a time. If your music involves playing chords, you'll need at least as many voices as there are notes in your most complex chord available. In practice, a thirty-two voice tone source like the MT32 is capable of generating a lot of music.

Every voice in a MIDI tone source is assigned a number. Aside from note data, the MIDI bus can carry a number of other standard information packets. One of these is a program change message. This allows a piece of music being played back by a sequencing program to not only play the voices in the tone generators which are reproducing it, but also to change voices.

For example, in the Canon there's a bit in the middle which has a lot of thirty-second notes and rips along at quite a pace. Played on a fairly long-winded voice with a lot of sustain, this turns into mud. You could have the voice change at this point to be something a little more staccato... log drums or perhaps banjo if you want to be really offensive.

Program change numbers are another thing which isn't consistent between different manufacturers of synthesizers. As such, voice twelve may be a harpsichord on one tone generator, a violin on a second and Martian wind chimes on a third. In addition, most contemporary tone generators and synthesizers allow you to download new voices to them over the MIDI bus, or otherwise select different sets of voices internally, so they may not even be consistent from one day to the next in the same instruments. It's up to you to make sure that you're playing through the right voices.

The issue of voices is one which delights many MIDI performers. Most higher end MIDI synthesizers and tone generators allow you to run dedicated voice editing and library software which makes it possible to modify their voices to suit your music. Because these instruments have fairly subtle tone synthesis systems, you can usually generate some pretty sophisticated sounds. I have a bank of harpsichord voices for one of my MIDI tone generators which spans the range of the instrument... it includes voices for old French and German harpsichords, harpsichords with pig bristles and nylon picks for jacks and so on.

It's also worth noting that there is another class of tone generators for MIDI, this being samplers. A sampler will digitize real acoustic sounds and allow you to play them back as MIDI controlled voices. You can use both original voices which you sample yourself and "canned" voices provided by the sampler manufacturer. As such, you can sample a real violin and then play that from any MIDI note source. You can also "play" musical car horns, trash cans, ringing phones, barking dogs, screeching cats, breaking glass... the possibilities are staggering.

MIDI to the Max

There is a great deal more about MIDI which hasn't been discussed here. A MIDI system can control things like program mix down and stage lighting, for example. The latest generation of PC sound cards allows you to have all the flexibility of MIDI without very much external hardware. The range of specialized MIDI gadgets could be an article of itself.

The best way to learn about MIDI is to plug it in and try it. Inexpensive MIDI hardware exists which will let you get into MIDI performance for a few hundred dollars. If you have a personal computer you're already half way there... MIDI interfaces exist for IBM PC compatibles, the Apple Macintosh and the Atari ST, among others.

It's also worth noting that a growing number of systems include MIDI interfaces. The IBM PS/1 comes complete with a MIDI port built in. All you need add is the music. ❐

Wright *Cont'd from page 15*

about how to transmit electricity 11 miles from a hydro-electric plant at Montmorency Falls to Quebec City, Wright suggested that Thomson pile up 11 miles of wire in a warehouse at the falls and hook it up. "Thomson made the test— and it worked!," his son did, "So did the long-distance lighting system for Quebec city."

J.J. Wright died in 1922, the same year the Toronto Electric Light Company, a company Wright had created and managed for most of his professional life, was absorbed into Toronto Hydro. But his system wasn't completely abandoned or forgotten. Wright's ideas and belief in electricity lit up the city in the dark years at the turn of the century. And in many ways, those lights haven't dimmed ever since.

For more Canadian electrical history see the exhibit: "Bright Lights, Big City: the History of Electricity in Toronto," at The Market Gallery of the City of Toronto Archives running until June 23, 1991.

The author would like to thank the many groups who helped in research for this story including Toronto Hydro, Ontario Hydro, Toronto City Archives, and the CBC Broadcast Museum. ❐

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FEATURE

Making MIDI Music

by Chuck Ander

MIDI (Musical Instrument Digital Interface) is a language standard for the communication of musical information. It can also be used to record and play back musical information using a sequencer (MIDI recorder) and a MIDI keyboard. A sequencer can record, edit and play back musical information in the form of MIDI data.

Sequencer Plus Gold

The sequencer I used is from Voyetra, a company that has developed a full line of MIDI products. It is called **Sequencer Plus Gold** and it runs on an IBM compatible PC. To turn your personal computer into a fully equipped MIDI studio, you will also need a MIDI interface board. Again Voyetra provided the necessary hardware in the form of the **V-22 Professional Dual-Port MIDI Interface**. The V-22 is an inexpensive interface board which uses a software driver (instead of hardware on the board) to communicate with the programs running. Some advantages of this are MTC sync, multiple MIDI ports and mute/solo while playing. However, if you have software that requires 100% MPU-401 compatibility, you can obtain a module which will make the V-22 into a **V-22m**, a fully MPU-401 compatible unit.

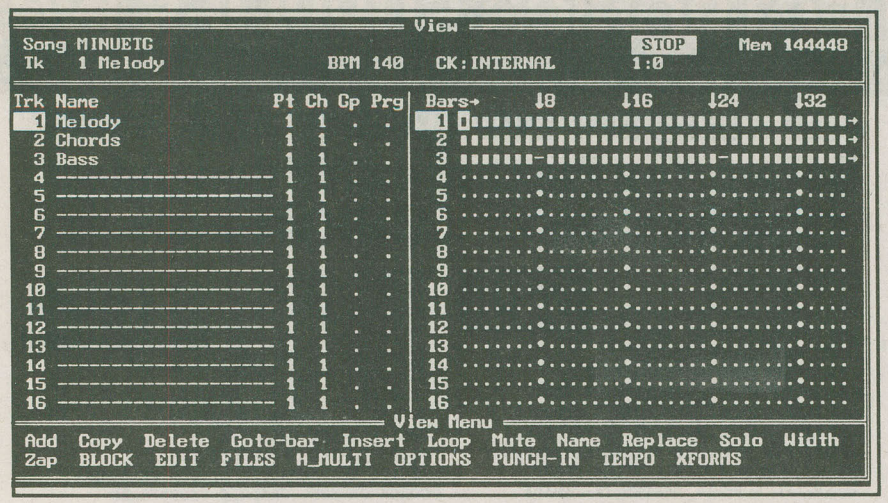
The board installed flawlessly and passed its self-test with flying colours. Next, Sequencer Plus Gold was installed and fired up. Lastly, I connected a multi-timbal MIDI keyboard to the MIDI in and out jacks and we were ready to roll. Now I needed something to record. Instead of trying to play chopsticks or some equally inane (and badly played) piece, one of the people in the office who is a real keyboard guru played an excellent version of the organ part to "Light My Fire" by the Doors. With this as a basic track, I was able to add bass, drums and some other instruments. It was like doing multi-track recording — except that what was recorded was not sound (or an electronic representation of sound) but digital information which, in order to be played back, needed a multi-timbal MIDI keyboard or sound modules to reproduce the original sounds. When played back, the piece sounded exactly like the original — except that you could finely edit the information, once it was on the disk. You can, of course, change the tempo or the key, or mute any track while the piece is being played back.

Sequencer Plus Gold has all the features you could want in a professional MIDI sequencer including: a graphical "piano-roll" form, making it easy to view and edit with great detail, memory buffers which allow you to cut and paste sections of a song or move them into a different song, and features to organize and modify tracks using name, mute solo, quantize, lop, offset and transpose commands. In addition, Sequencer Plus Gold includes a Universal Librarian program and a MIDI Data Analyzer.

With the Universal Librarian program you can arrange, name and archive MIDI instrument programs onto PC disk and audition sounds in most MIDI instruments from your PC's keyboard. It also includes a complete voice editor and librarian for the Sound Blaster™ FM synthesizer.

MusiClips

MusiClips is "clip art for music." It is actually quite a large collection of multi-track MIDI song files which cover a wide variety of musical styles. These files are perfect for adding music to multimedia presentations, film and video productions, commercials, or practically anything. When used with a sequencer program, you have a ready supply of songs to use and/or edit. You can audition variations of the same song played by a piano, string section or any other instrument supported by your MIDI synthesizer or PC sound card.



Sequencer Plus Gold "View" Screen

L.M.P

L.M.P (Laser Music Processor) from Teach Services is one great music notation program. Many years ago I used to write songs and I'd try to transcribe them into music notation. This was a messy and laborious task, at best. How I wish I had L.M.P, a computer and a printer back then!

With L.M.P, you can write music notation using a mouse (or the cursor keys) and the program will automatically draw any kind of staff. It also features automatic key signatures and can produce symbols for fermata, segno, repeats, arpeggio, and coda. In addition, it can create adjustable ties, slurs, and beams. Songs can be up to 100 pages long.

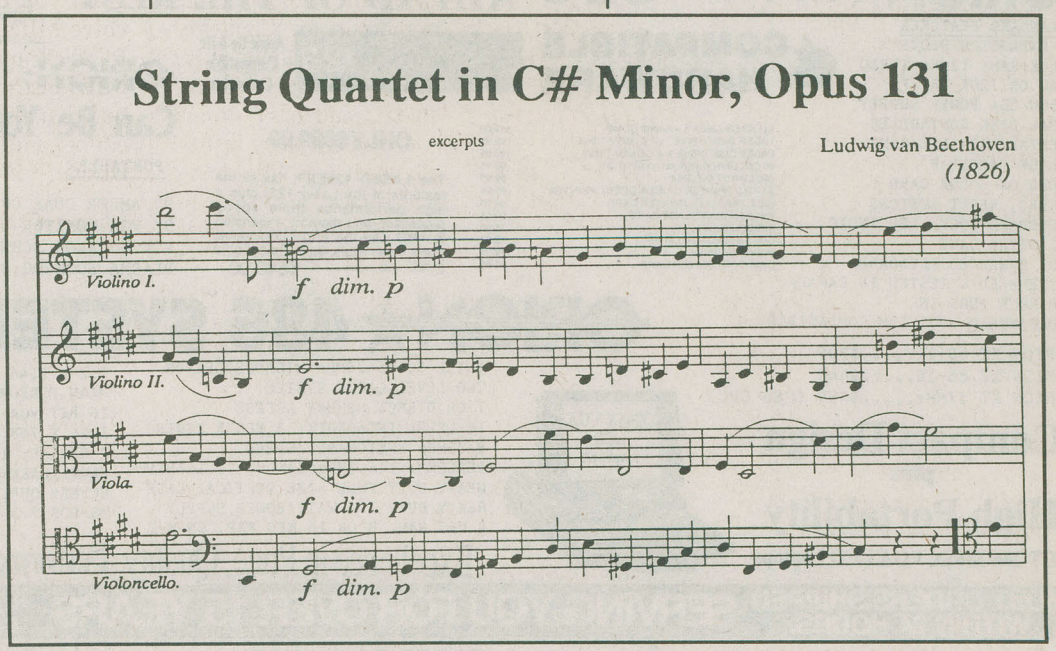
Printing might be the best part of the program (except for the automatic transcription from a MIDI keyboard) L.M.P prints like a dream. I used a LaserJet II compatible printer and the print quality was excellent — just like sheet music you'd buy.

My favourite feature (as you may have already guessed) is automatic transcription. To test it, I got our resident keyboard genius to play a piece and a short while later presented him with a laser-printed copy of what he had just played. The program will quantize to 4th, 8th, 16th or 32nd notes and adjust inter-staff spacing. What can I say, it's nice and solves a very real need — that of producing high-quality and correct music notation.

Band-in-a-Box

It's hard to have a favourite program among all these great ones, but Band-in-a-Box just might be it. Maybe it has something to do with my experience many years ago of sitting laboriously over my tape recorder, trying to synchronize my rhythm box and pathetic bass playing in order to create an accompaniment tape. I should explain — I used to perform music, playing the guitar and singing. To enhance my performances I recorded drums, bass, and sometimes lead guitar on a tape and played along with it. It actually didn't sound too bad. But sometimes I wanted to change keys, or speed it up a little. Then, I had to do my recording all over again. This was a heck of a lot of work. Now, along comes **Band-in-a-Box** from PG Music Inc., a program that does all this (and more) automatically. And the painful part is that its bass lines are better than mine!

To use Band-in-a-Box, all you have to do is load a song (from any of over 500 in the MIDI-Fakebook collection) or type in the chords to any song you please. Once you type in the chords, you next choose one of 24 musical styles such as country, light, medium or heavy rock, reggae or whatever. Then just press <F4> to start the program and it will create a drum, bass and piano part for your song and play it through your MIDI synthesizer. You can vary the part anywhere in the song. For example, you can slow it down or speed it up, change styles or change the time signature for varied effect. If you realize that the song is not in the right key for you, you can transpose to any key — and all the chords are likewise automatically transposed. You can vary the tempo and even play the same song in a different



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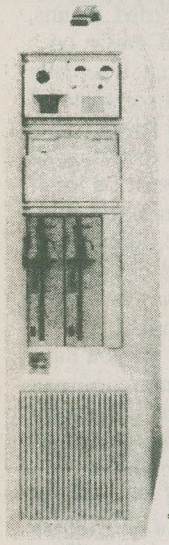

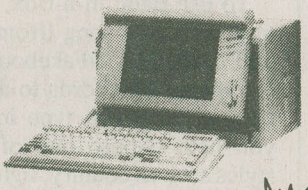

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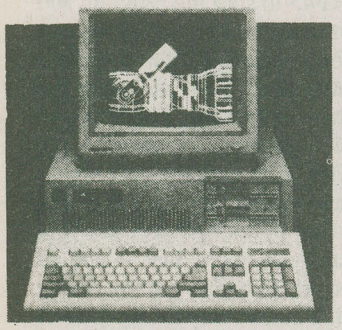

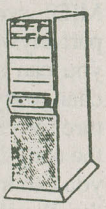

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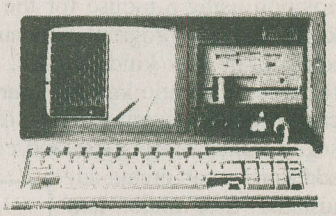

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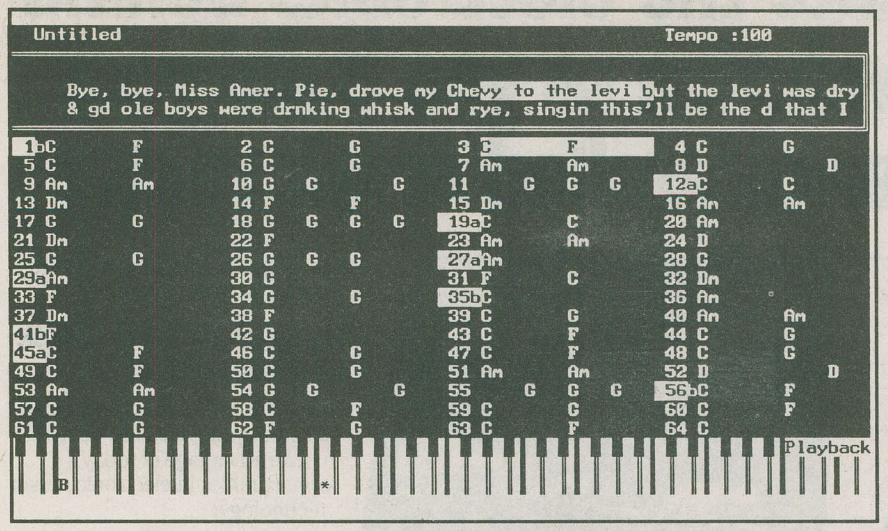

Band-in-a-Box Playing a Song

musical style. By assigning different MIDI channels, you can change the sound of the instruments the program plays.

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I should point out that both L.M.P and Band-in-a-Box need an IBM compatible PC with an MPU-401 compatible MIDI interface. I used the V-22m from Voyetra to run these last two programs.

Read All About It

It always helps to have a good understanding of the basics of any discipline. A really excellent book that helped me learn about MIDI is, ***MIDI The Ins, Outs & Thrus*** **by Jeff Rona**, published by Hal Leonard Books. This book is written in an easy-to-understand, simple and often humorous style. It takes a difficult subject and explains it in a clear-cut manner. It starts with a brief history of the events and needs that led up to the creation of MIDI. It explains the basics, gradually progressing to more complex portions of the subject. Finally, it explains how to set up a MIDI system, and provides the solution to common problems.

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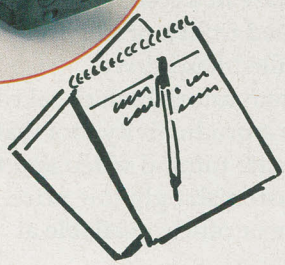

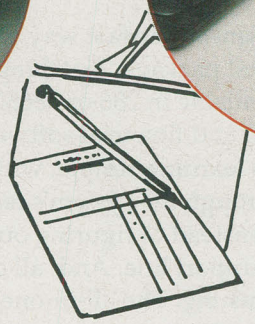

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An Office in your Basement

by Steve Rimmer

Working at home offers some intriguing possibilities. It removes you from the distractions of a conventional workplace without necessarily depriving you of the resources of an office. The state of the art in computer technology may allow you to access the state of the art in office environments... the total lack of one

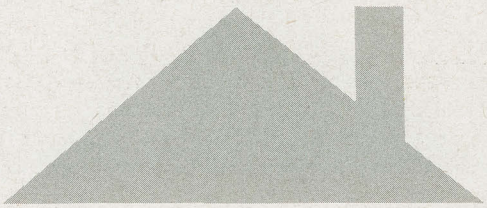
The best way to get any work done in many conventional offices is to call in sick. This only works occasionally, of course... after a while your co-workers will probably realize that you aren't really sick and start phoning you at home. Alternately, you'll get fired, which is certain to free up some of your time but has some nasty drawbacks as well.

If your job involves using your brain a lot... as opposed to simply being somewhere predictable so people can come and talk to you... you'll probably find that offices aren't conducive to the proper operation of the human mind. There are too many distractions. You probably spend a lot of worthwhile, otherwise useful time getting to and from your office. The air smells funny in most office buildings. There are entirely too many phones.

Ten years ago, most jobs would not have been flexible enough to allow you to work at home. However, with the available computer and computer-related technology which can be carried into one's basement, you might find that you can escape the restrictions of an office quite effectively by simply not showing up.

Consider the advantages of working at home. You can immediately get more work done because you won't have to spend part of your day commuting. You also won't have to spend part of the remainder of your day recovering from commuting. You can avoid a lot of the phone calls which, if not answered promptly will usually just go away. You can miss meetings, which are likewise very often dispensable. You can focus your energies and attention on a single task and complete it.

I've worked full time in a home office now for about three years. It's a wonderful place to work. Most of the problems which people mutter about when the topic of working at home comes up... the distractions of having your family about, the temptation to loaf and procrastinate and so on... are surprisingly easy to deal with.



Working at home offers some intriguing possibilities.

The amount of work which can come out of one's basement is staggering.

One of the reasons that home offices work as well as they do is that technology allows you to cheat on the concept. You can have most of the resources of an office available to you without actually being in one. Specifically, you can use a computer to do your work with just as you would in a conventional workplace. A modem will allow you to transfer documents of all sorts between your home and your colleagues at work... or at *their* home offices... and a FAX machine will let you deal with those remaining forms of communication which don't lend themselves to file transfers.

The hardest part about working at home is usually convincing the people you work with or work for that you're not actually loafing or procrastinating.

The PC Connection

There's nothing particularly sophisticated about the technology you'll need to work effectively at home. The computer you use to work in your basement will probably be a lot like the one you work with at the office. However, there are a few things to consider about choosing hardware which will span the distance between your two workplaces.

There are few things more frustrating than discovering that you're at home and the file you need is at work. There are ways of getting around this, of course... we'll discuss file transfers in a moment. However, you can forestall a lot of delays and inconvenience by thinking about how you work with files when you chose hardware.

A growing number of people who use a computer at home and at work do so with provision for taking all their files with them when they leave the office, rather than simply transferring the ones they think they'll need to floppies. Laptop and transportable computers are ideal for this. If you have a monitor and keyboard at home and another at work, you can effectively treat a portable as if it were a conventional desktop computer. There are portable systems powered by high-end 80386 processors with megabytes of memory... everything a conventional system can offer. However, if you take the whole computer with you, there's nothing left to forget.

A high end laptop with a full size keyboard and a good analog monitor plugged into it... virtually all business portables allow for this... makes for a first class system.

This also means that you need not worry about someone getting access to your system when you're not in the office. At worst, they can purloin your keyboard.

A second approach is to use a removable hard disk in a desktop system. Removable hard drives are specially designed so that the actual disk platters can be interchanged. You can take the whole drive with you and plug it into your home system, making it effectively identical to your computer at work.

There will, of course, be instances in which you'll want to exchange files with your colleagues at work. This may involve sending down a report for someone else to read, passing along a Lotus worksheet for other members of your department to consider or getting some desktop publishing printed out on the company laser printer. In all cases, you can send files across town or across the world with nothing more complex than a couple of modems and a telephone line.

Modems allow you to send a file from your computer to one at your office, that is, to *upload* a file, or to retrieve files from your office, to *download* them. While formerly a pretty technical process, file transfers have become pretty commonplace and modems much more friendly.

One of the things which make file transfers easy to manage is the sophistication of "host" software. The host I use is called QModem. I can leave QModem running in its host mode on my computer at home and effectively have access to the system from anywhere else I happen to be. Likewise, you can leave a host on a computer at your office and send and receive files from home without anyone at your office having touch your system.

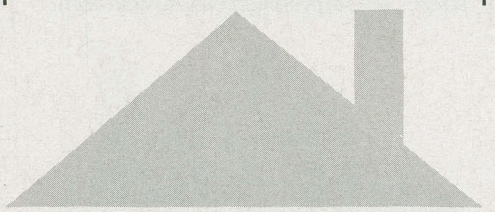
Host software effectively turns the computer running it into a small bulletin board. This typically includes sufficient security to keep the files on the computer safe from unauthorized callers. The host function of QModem also includes a "doorway". This means that aside from sending and receiving files it lets me actually get down to a DOS prompt over the phone line and run programs remotely.

In addition to being simple to use, the facilities to transfer files need not even be terribly expensive. You can get suitable modems for less than a hundred dollars each. The QModem package costs about fifty dollars. Transferring a two thousand word document takes less than a minute at 2400 baud, the speed of conventional low speed modems.

You can get faster modems if you'll be moving a lot of files around, but they're quite a bit more expensive.

The last link in connecting a home office to a conventional one is unquestionably a FAX machine. Despite the greater utility of moving actual document files around, most people are used to working with paper. In addition, there are a lot of things which simply never exist as files.

Inside every big FAX machine there's a little FAX machine trying to get out. The sophisticated... and expensive... FAX systems which typically support offices can't do much of importance that a small personal FAX machine lacks. Specifically, a simple six hundred dollar personal FAX system will allow you to transmit and receive documents anywhere in the world. I use a Canon Faxphone 8, which has fewer features than most telephones. It communicates daily with places most people can't even pronounce the names of.



Modems allow you to send a file from your computer to one at your office.

Small personal FAX machines are available specifically for home office applications. If you don't want to have a dedicated FAX line installed in your home, you can use a FAX machine which will discern the difference between voice and FAX calls. There are also combination FAX and answering machines, which will verbally instruct callers to either leave a spoken message or to turn on their FAX machines.

FAX gets along well with computers. You can, for example, get a FAX board to plug into your system. This will allow you to send documents as FAXes directly, without having to print them out. Aside from saving paper and a lot of time, documents FAXed this way are decidedly more readable when they arrive at wherever they're going. FAX boards are not prone to the scanning errors and other aberrations which mechanical FAX machines are.

Many of the newer FAX machines will interface with your computer directly. This allows you to send both conventional paper FAXes and digital FAXes from your keyboard. It also means that your FAX machine can double as a scanner and even as a printer if you're really stuck.

Going Home

The reality of working effectively at home is, of course, a lot more complex than just buying a few boxes and plugging them in. A lot of what makes it successful... or not... is considerably more intangible. Not everyone has the motivation and personal discipline to get to work when it's sunny outside and there are dozens of more interesting things to do.

If you do, however, you'll find that nothing beats the office in your basement.

The technology of a home office isn't really what makes it work but it is what makes it workable. It allows you to erase the distance between you and your office, but only when you want to. Switch off the modem, ignore the FAX machine, power up your home system and all the miles between you and the bedlam of your office will suddenly be in place again, insulating you from distraction.

If your job relies on your performance and productivity, not showing up for work might well turn out to be the best thing you can do for it.

Steve Rimmer is the former Editor of Computing Now! Magazine, and a successful fiction and computer book author. He is currently working on The Home Office Book, which will be available in the near future from Sybex.

Product Review: MaxFax 9624

When space is a consideration around the home office, this handy PC add-in may be just the ticket.

The MaxFax 9624 fax/modem may be the solution that some of you have been looking for in terms of your home-based communications needs. This neatly packaged unit lives on a standard half-slot card that is suitable for use in all desktop PCs and a good number of portable computers as well.

Configuration and installation of the MaxFax are fairly painless procedures. It requires the use of a spare COM port that is jumper-selectable on the card, not a big problem but this editor prefers softswitches any day! Loading the accompanying software was a snap (only two 360K floppies to copy to the hard drive); and the whole configuration procedure was menu driven with support provided for all the common displays from CGA up to VGA. The rear of the card houses two RJ-11 jacks for connecting a telephone and line input.

Hardware Personalities

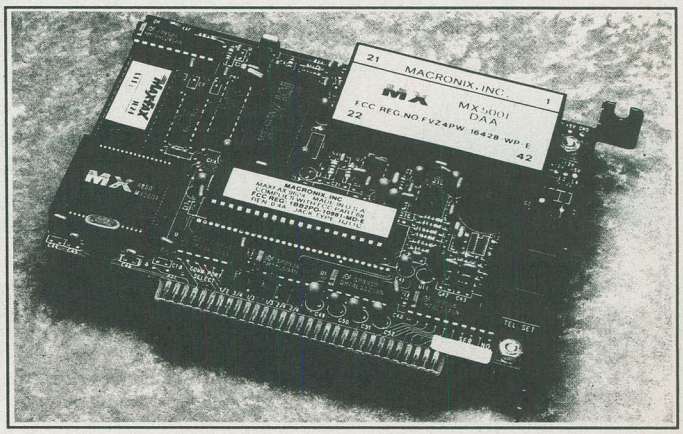
The fax portion of the unit sports 9,600 baud, Group III CCITT T.4 and T.30 circuitry that is capable of sending and receiving faxes to and from the vast majority of installed machines around the world. Although it is a 9,600 baud fax machine, it is capable of "falling back" to 7,200, 4,800, or 2,400 baud to match the speed of the remote fax if necessary. The card has intelligence too. It's able to automatically detect the origin of the incoming call — be it from a fax or a modem — freeing the user from reconfiguring between and fax and modem modes. The MaxFax can also be used in conjunction with a UMAX scanner, or a scanner such as the HP ScanJet that supports PCX-type files. We'll touch on the graphics aspect of incorporating logos etc. into faxes in just a moment.

The MaxFax's other personality, the 2,400 baud Hayes-compatible modem, is a pretty straightforward device that operates on the standard AT command set. The documentation gives a complete list of the command set and functions, as well as information on originating and answering modem calls.

Fax Software

The software accompanying the MaxFax lives in two separate modules: FAX and BFAX. The first allows for sending, receiving, viewing, printing, scanning etc, all done from the foreground. It is also the basis for operating the MaxFax from the DOS prompt should that be required. Simply typing *fax s /fMYFAX.TXT /d619-555-1212 will fax the file MYFAX.TXT to the telephone indicated after the /d switch in the command line.*

BFAX, as you might have guessed, runs in the background allowing users to be busy with other applications while the MaxFax awaits incoming fax and data calls. Note: some other applications may be too large or disk intensive for this utility to work efficiently since BFAX eats up a little over 133K of memory.



MaxFax also allows scanned images (in PCX file format) to be faxed, logos to be merged with text files, and it also allows for queued faxes to be sent in bunches etc. at a specified time.

Modem Software

The MaxFax's modem capabilities are quite adequate, and for those who operate under comm packages such as Crosstalk, Procomm, QModem etc. there should not be any difficulties. I connected to the SUZY online system without any trouble whatsoever, and no adjustments were necessary to SUZY's configuration file.

The MaxFax, aside from being just a conventional fax/modem, can also be used to set up a simple bulletin board system that will allow unattended and restricted password access to your system and files. Simply by creating two text files with your word processor - PASSWORD.BBS and FILES.DIR - you can restrict access to your system. PASSWORD.BBS contains a list of names and passwords of those who are authorized to access your bulletin board; FILES.DIR contains the list of files accessible by the authorized users.

The Bottom Line

The MaxFax 9624 performed admirably and without any difficulties. It's simple to use, comes with readable, useful documentation and is supported with a one-year warranty. However, the toll-free support hot-line number is good only in the U.S. The regular price of the MaxFax is $295 in Canada. Good news though, a special intro price of $199 is in effect until June 30, 1991. At this price, the MaxFax is a bargain for what you get. For Windows 3.0 users who are hungry for a product such as this, we have been assured by the manufacturer that there Windows 3.0 in the works. We'll keep you posted.

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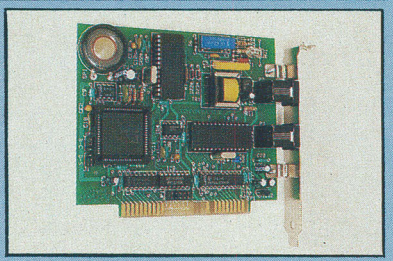

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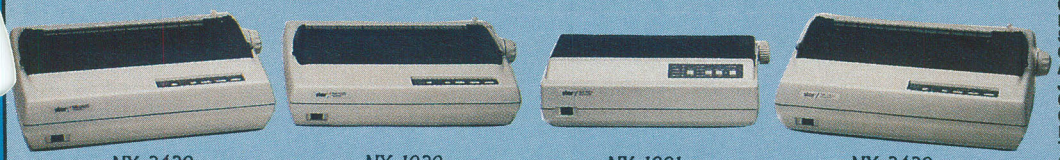

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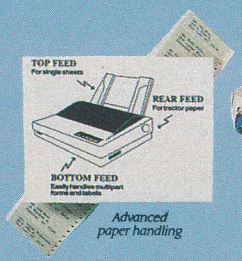

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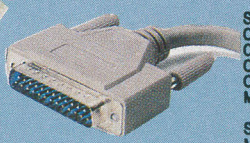

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The nature of business today relies on direct, fast and accurate communications. As a result, fax machines have become an office necessity for even the smallest of companies. Although fax machines provide many practical conveniences, supplies and maintenance could prove to be very costly for small businesses concerned about their bottom line.

Keep It Clean

If fax copies are blurred, it may not be the fault of the equipment, but the cleaner — or lack of cleaner. To work properly, fax machine printheads need a regular and thorough cleaning. Without a proper cleaning, dirt-deposits can build up on printheads ruining the quality of printed copies. Small businesses can cut fax maintenance and usage costs by having an employee responsible for keeping the fax clean. Fax and photocopier cleaning kits are available from office supply outlets; these often come with complete instructions that make it very easy to perform the necessary maintenance.

For Every A Fax — Paper

Experiencing excessive machine jams? Before calling for expensive maintenance repairs, check the paper. Everyone loves a bargain, but using inexpensive fax paper could end up costing more with resulting jams, delays, and repairs. Fax paper should meet OEM standards and be compatible with the specific fax model. Be sure that the paper you are purchasing is the proper width (8.5-inches), bright white for excellent contrast and provides low curl to avoid machine jams. Also check that the paper provides an archival factor for excellent copy life and a bright red end-of-roll warning stripe to minimize unnecessary delays.

Surges, Spikes and Glitches

A sudden surge of electrical power could damage expensive fax equipment and cause transmission problems. Surge protectors are available for use with faxes and copiers and these provide protection to both AC and data lines. These units act quickly to protect data and equipment from transient voltage surges, spikes and glitches that can cause garbled and missed communications. Simply plugged directly into a wall socket with an in and out modem jack for both fax and phone, surge protectors provide a much-needed margin of safety for users.

Linear-Sharing Cut Costs

For many small businesses the cost of an additional phone line for the fax may be prohibitive. Technology, however, has come a long way and intelligent and inexpensive devices exist that allow small businesses to share a phone and fax on one line. By detecting the type of incoming signal, phone/fax line sharing devices determine the destination - be it the phone or fax - and the user need never know the agony of having to manually switch the cables in the wall jack.

Our thanks to Moore Business Products, a division of Moore Corporation Limited, for their assistance. Moore specializes in supplying small businesses with the widest selection of computer and office supplies. For more information on Moore's wide range of quality products, please contact them at Suite 450, 4 Robert Speck Parkway, Mississauga, ON L4Z 1S1; Phone: (800) 387-7810; Fax: (416) 270-3130. Moore provides a catalogue of their products in both English and French.

Industry View: Sanyo

The home/office is rapidly becoming a common and well-recognized working environment in the society of the '90s.

Products previously found in corporate offices are now available at prices and with features which support and encourage this trend.

Sanyo provides a variety of products and technologies which enable users to conduct their businesses or professions effectively and efficiently from their homes.

Sanyo's extensive experience in consumer electronics has enabled the Company to develop a sensitivity to the needs of the home user, and this is reflected in the features and products provided.

In addition, Sanyo recognizes the different service and support needs of people. Some prefer the convenience of buying from the electronics departments of major retailers. Others may require the more detailed advice and service options which are provided by a specialist dealer. Sanyo home/office products are available from both.

In the area of information processing, Sanyo currently has two notebook computer products, offering tremendous portability with no loss of functionality. Both the MBC-17NB 80286-based and the MBC-18NB 80386SX-based models offer VGA screens, high-quality keyboards, floppy and hard disk drives, quick charge battery capability with typically more than three hours of battery life - all this for under seven pounds.

At the heart of hard copy communications in the home office is the 'fax' machine and Sanyo has developed two compact facsimile products, both incorporating advanced technology.

The most important features offered in the Sanfax 75 are: five-page document feed; handset with 20 number memory; half-tone capability for pictures and robust construction. The SF225 also features 10-page document feed, wide paper capability and can eliminate junk fax. Both units have a two year warranty.

In the changing world of voice communications, products for the home office have not been left untouched.

Telephone answering systems are offering more features like time/date stamping and user-selected security which are very popular with users.

Sanyo's TAS 346 offers instant call erase; time/day voice storage; 20 digital security codes; room monitor/paging and full beeperless remote. The TAS 360 has 100 digital security codes and LED digital call counter, in addition to all of the features offered on the TAS 346.

Communications are an important requirement for the home/office and since the typical home environment may have only one telephone line, all units (telephone, facsimile and answering machine) must share this line efficiently and easily. This concept is central to Sanyo's approach to communications products for the home/office user.

In addition, the separate fax and answering machine concept allows users to have separate units with individually-specified features. It also allows them to place each unit in a different location which is a common requirement for the home environment. As well, if one product becomes unserviceable and is out for repairs, the customer still has the use of the other product. Clearly, this would be a problem where fax and TAS are combined.

A cordless phone makes calling easier in the home/office and many Sanyo models offer Compander (R) or Super Compander II (R) noise reduction circuitry which provides sound quality similar to that of a traditional wired phone. The CLT 5600 Compander unit offers two-way intercom and paging; 10-channel auto access and 256 digital code security, along with a number of other standard features found in cordless phone products.

The CLT 8710 Super Compander II model has a dialing keypad and speaker phone on the base unit, in addition to the keypad on the handset. It also offers automatic standby, intercom/room monitoring, as well as all of the features provided on the CLT 5600.

Many home office users have a requirement to record information quickly and to retrieve it later at a more convenient time. One product category which is often under-rated in its capability to increase productivity in the home office, is the dictation machine.

Sanyo has three products in this sector which are designed to meet home office requirements - the TRC 550M, 5680 and 6100.

The TRC 550M is a voice-activated microcassette system with one-touch recording, quick record/review and two-speed recording, among its other features. The TRC 5680 model offers the same features plus dictation/conference and one-touch recording.

Sanyo's top-of-the-line dictation unit, the 6100, is the smallest, lightest microcassette recorder in the world and provides the ultimate in portability and flexibility for voice recording. The unit has a cue system index, a tie-pin microphone and fast playback system, as well as being designed for easy, one-hand operation.

As vendor organizations continue to address the needs of the growing home office market, product features and characteristics will be enhanced with new technology. In the 1990s, the growth of the home office market will make it a significant one for vendors with the right product mix.

Beamscope helps IBM bring the PS/1 home

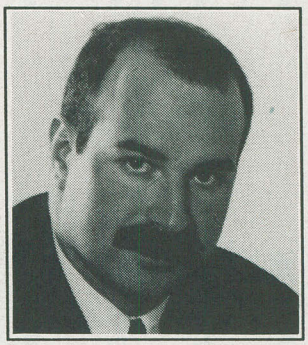
by Morey Chaplick

For years futurists have been giving us visions of high-tech equipment capable of instant communication and incredible productivity. The "Jetson's" way of life is one such vision which glorified the technology which would one day be ours. Perhaps the biggest surprise to those of us expecting such hi-tech change has concerned not *how* we work, but *where* we work.

Beamscope Electronic Entertainment, Canada's sole distributor to specialize in home office products, has experienced, first-hand the trend away from computers purchased for entertainment purposes and towards purchases for: bringing work home, starting a home business, and for productivity as well as entertainment reasons. In the early 80's, the primary reason for home PC purchases was fun and games, today it has become the key to productivity and success. In fact, Beamscope considers the home office to be the consumer "product group of the 90's."

Beamscope estimates that by the year 2000 as many as 40 percent of Canadian workers will be working out of their own homes. Beamscope's Home Office Division was formed to quench the thirst for quality home computing products, and currently distributes a growing family of home office products to its 1900 dealers across the country, namely: facsimile machines, laptop and notebook computers, personal copiers, electronic organizers, home office furniture, modems, telephone management devices and now desktop computers.

Manufacturers have quickly recognized the growing market for compact and cost-efficient products which are specifically designed for home office use. IBM, for example, the world's undisputed computing leader, released in mid 1990 an innovative new home computer, the IBM Personal System/1 (PS/1). The PS/1 was an immediate success with thousands having been sold in Canada to date. To most computing enthusiasts the reasons for IBM's success is clear. IBM is considered to be the "original" leader in the computer industry when it comes to: reputation, reliability, integrity, innovation and compatibility. IBM has also led the industry in product stabilization, providing purchasers the security which they demand.



IBM effectively targeted the home office market and produced a desktop computer that hit the "bull's eye." Simply put, the PS/1 provides a perfect solution for home users:

* The product itself - CPU, mouse, modem, colour monitor and software is complete and easy to set up.
* Ease of use.
* Good value.
* Warranty and service (a complete package).

In order to further the success of the PS/1 line, IBM has recently appointed Beamscope as the Canadian distributor for the PS/1. In that Beamscope has a 100% focus on the home market, and a highly developed retail base which serves the home office market, the fit is considered to be a natural. IBM's strength has been the ability to produce a home computer that's powerful enough to handle work brought home yet simple enough for the whole family. Beamscope's goal is to assist IBM (who has created a PC which is incredibly simple to set up, learn and use) in making the PS/1 just a bit easier for the customer to purchase.

Morey Chaplick is the Executive Vice-President of Beamscope Electronic Entertainment.

News and New Products

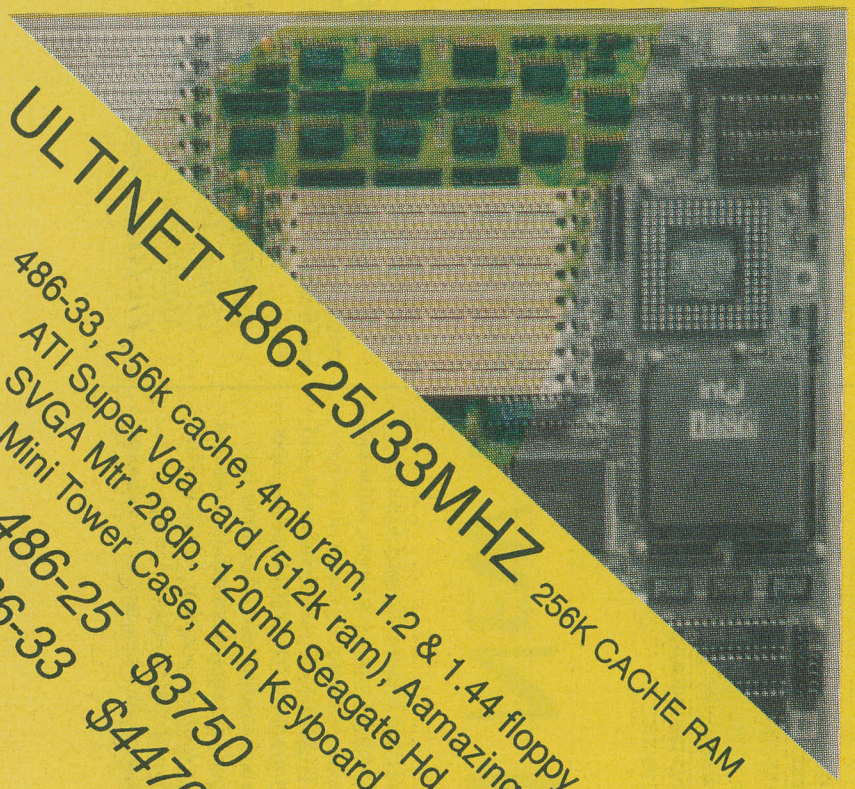
Toshiba's P301 features portable dot matrix printing

Toshiba Information Systems Group has introduced the P301, a portable dot matrix printer weighing 4.2 lbs. and using a thermal transfer, non-impact print method to produce letter quality copy on regular or thermal bond paper at 35 cps or draft quality at 50 cps.

The P301 features Epson LQ series and Toshiba/Qume emulation, and standard type fonts include Courier, Prestige Elite, High Speed Draft, Condensed, and coded-graphics. The P301 handles paper via an autoloading, uni-directional friction feed, and supports a standard parallel interface, quiet operation, ASCII and International character sets, 180 dpi graphics capabilities, and an AC adaptor for continuous power.

Accessories and supplies include a carrying case, ribbons, and a thermal paper roll holder.

Toshiba Information Systems Group, 191 McNabb St., Markham, ON L3R 8H2; Ph: (416) 470-3478.



ULTINET 486-25/33MHZ 256K CACHE RAM

486-33, 256k cache, 4mb ram, 1.2 & 1.44 floppy
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SVGA Mtr .28dp, 120mb Seagate Hd
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Smart Buy.

The board has a Direct Mapped Cache Controller inside to support a "0" wait 80486 Microprocessor. It stores a copy of frequently accessed data/code from main memory in a "0" wait local Cache RAM. With this Cache Controller almost all critical paths are relocated to relatively small Cache RAMs (SRAM) and DRAM timing is no longer a major issue.

Although a traditional write through cache can read data from an SRAM with 0 wait, it is difficult to write to a DRAM with 0 wait. (Write through cache has to update the DRAM no matter if it is a write hit or miss). A very high speed DRAM allows you to reach 0 wait DRAM write, but the high speed DRAM will cost quite a bit more, especially when running an OS/2 or UNIX operating system where a large DRAM space is require.

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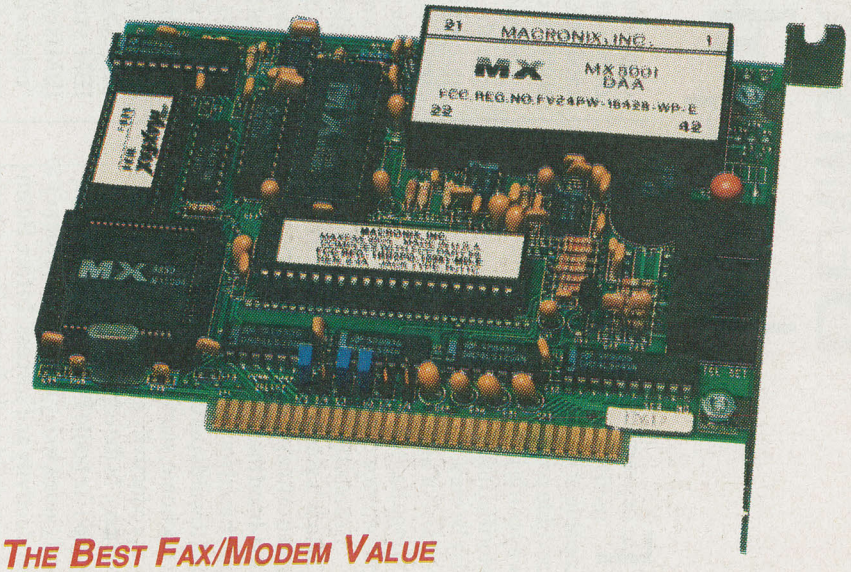

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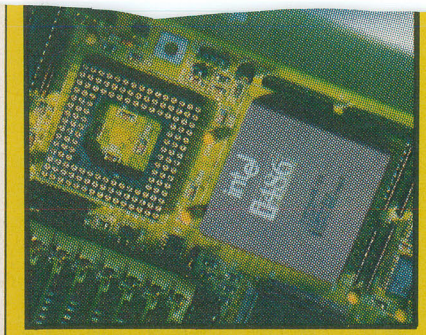
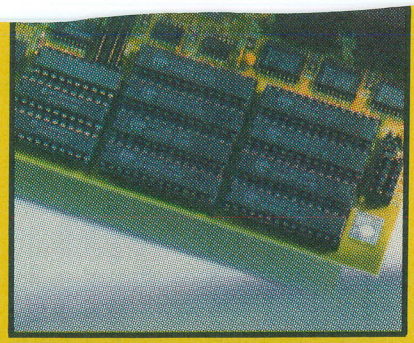
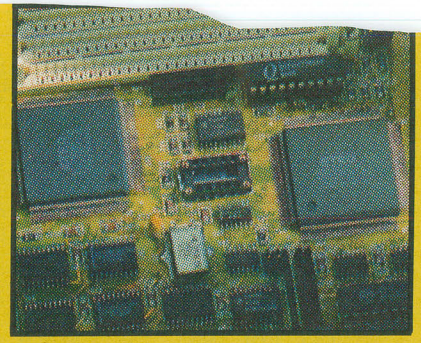


The i486 chip has a built-in numeric coprocessor, but Companion lets you augment it with a Weitek 4167.

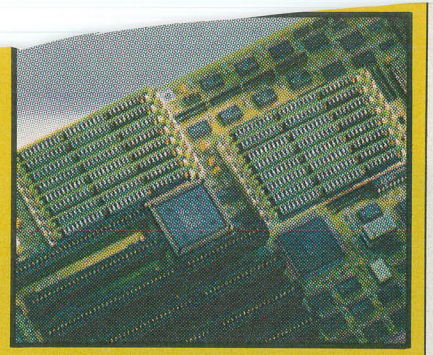
Circle No. 4 on Reader Service Card



Companion's secondary cache subsystem improves system performance to keep up with the ultra-fast i486.



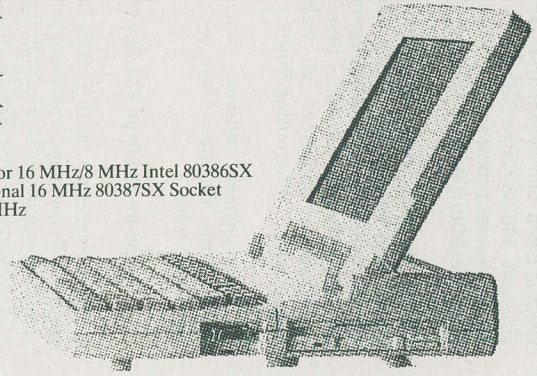
The ETEQ chip set uses integration to reduce space and wiring, so the board generates a minimum of heat.



The Companion mainboard accommodates up to 64 MB of memory, enough for the memory intensive applications of the future.

Small and Powerful

NoteBook 286/386SX



CPU:
- 80C286-12 Microprocessor 16 MHz/8 MHz Intel 80386SX
- 80287 Coprocessor Optional 16 MHz 80387SX Socket
- Dual Speed at 6 and 12 MHz

SYSTEM MEMORY:
- 1MB Standard
- 2MB, 4MB Optional
- EMS Support

BIOS:
- Phoenix

DISPLAY:
- 10" Supertwist LCD with CCFT Backlit
- 640x480 Pixels with 32 Gray Scale Levels
- VGA/EGA/CGA/MGA/Hercules Compatible Mode
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- Built-in 20MB Hard Disk
- AT-Bus Interface
- 25ms Average Access Time
- Programmable Power Off
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- External 5.25" Floppy Diskette Drive Optional

KEYBOARD:
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I/O PORT:
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POWER SPEC:
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PHYSICAL: *2 year parts & labour warranty*
- Weight: 3 kg or 7 lbs • Dimensions: 308mm(W) x 265mm(D) x 49mm(H) 12"(W) x 10.5"(D) x 2"(H)

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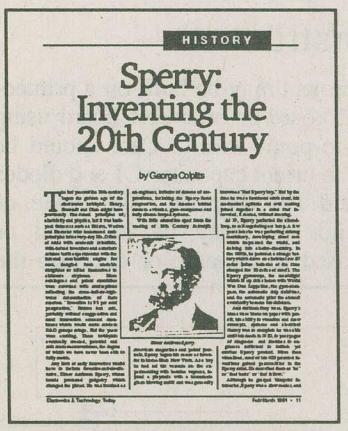
HISTORY

Sperry: Inventing the 20th Century

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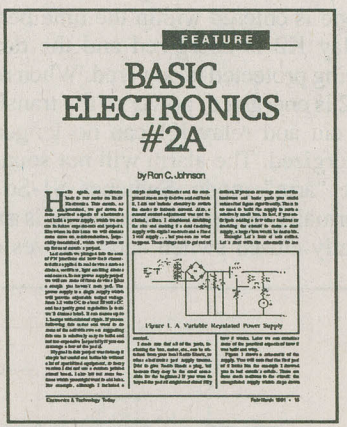
FEATURE

BASIC ELECTRONICS #2A

by Ron C. Johnson

The Basics of Electronics

FEATURE

University of Toronto Research

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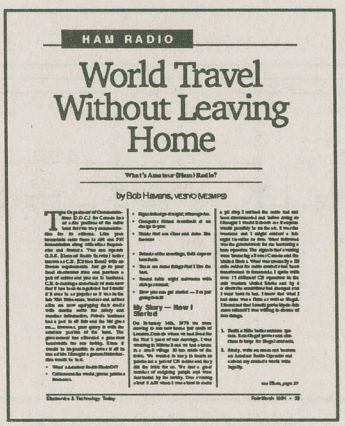
FEATURE

New Products

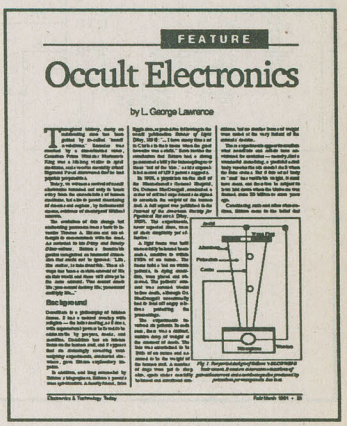
Exciting New Products


HAM RADIO

World Travel Without Leaving Home

by Bob Havens, VE3NO (VE3MPS)

Amateur (Ham) Radio


FEATURE

Occult Electronics

by L. George Lawrence

Fascinating and Unusual Stories

PROJECT

Electronic Sequential Combination Lock

by Stephen Kamichik B.Sc., E.E.T., B.Eng., M.Eng.

Ten years ago I designed the electronic sequential combination lock to protect my classic sportscar. The project is a power control system. If the code is entered within ten seconds, power is sent to the device being protected. If the code is not entered within ten seconds power is routed to the alarm. This project may be used to protect cars, boats, motorcycles, homes, offices, computers, etc.

Circuit Operation

The schematic for this project is shown in FIG. 1. IC1 is configured as a monostable multivibrator whose on time is determined by R17 and C1. If the code is not entered within ten seconds, relay K1 is energized and the alarm is powered. The code is entered by pressing S1, S2, S3, S4, S5 and S6 in the proper order, starting with S1. If the code is entered within the time period, relay K2 is energized and the device being protected is powered. When relay K2 is energized, power to the transistor is cut and relay K1 can no longer be energized. The alarm will not sound in the "arm" mode. Switches S1-S6 are normally-open switches and S7 is a normally-closed switch and it serves as a reset if the user enters the wrong code by mistake. Diodes D1 and D2 protect SCR6 and SCR7, respectively, from inductive spike voltages generated by the relays at switch on. SCR1-SCR6 and associated components are the "heart" of the combination lock.

Construction

The project may be built on a printed-circuit board or on a perf board using point-to-point wiring. Care should be taken to orient capacitor C1 and diodes D1 and D2 properly. The value of capacitor C1 may be increased or decreased to increase or decrease the

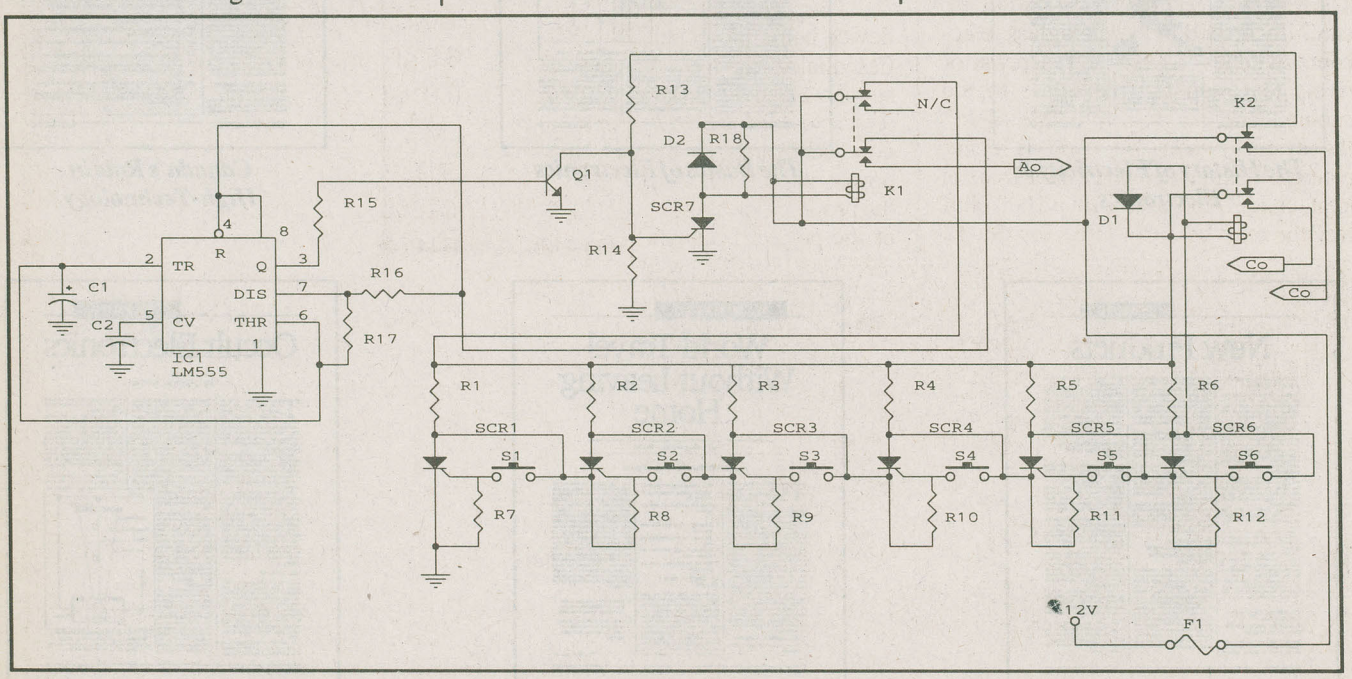


Fig. 1. Schematic of Electronic Sequential Combination Lock

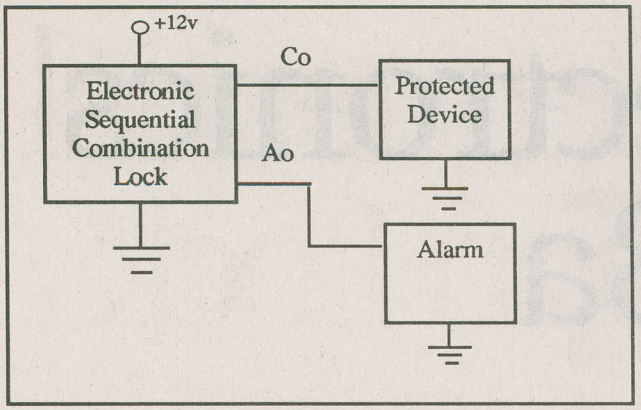


Fig. 2. Installation of Lock

time period, respectively, allowed for entering the code. The component values, except for R17, are not critical, that is, the next standard higher or lower value may be used.

My PCB was designed to accept the Magnecraft W67RPCX-2 relay. However, any relay may be used if point-to-point wiring is used. The relay contacts must be able to handle the current requirements of the device being protected and the alarm used in your system.

Cabinet Preparation

The front of the cabinet is used as a template to cut a piece of plexiglass. The cabinet front is then cut. Holes are carefully drilled in the plexiglass to accept switches S1-S7 and screws or rivets to fasten the plexiglass to the cabinet. Bulb L1 is used to "backlight" the system when the code is being entered. If the original cabinet front is kept, an LED in series with a 1000 ohm resistor may be substituted for the 12 volt bulb. The bulb remains lit until either the code is entered or the alarm is triggered.

Testing And Installation

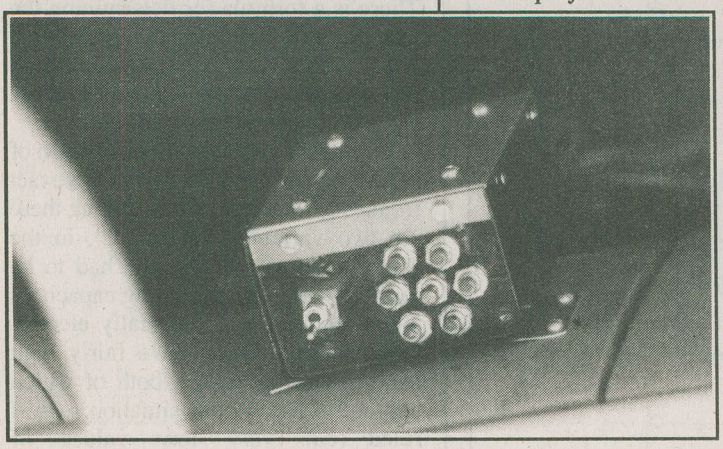
This project requires no calibration and testing is easy. A voltmeter should be connected to Co and a second voltmeter should be connected to Ao. A twelve volt power supply is connected to the +12 V and ground leads of the project. Turn on the power supply and do not enter any code, after about ten seconds, you should hear a relay click and measure twelve volts only on the voltmeter connected to the Ao lead. Press the reset switch and enter the code. You should hear a relay click and measure twelve volts only on the voltmeter connected to the Co lead. If problems occur, check for poor solder connections and for solder shorts. Make sure that capacitor C1 is a tantalum capacitor and that it is properly oriented. Fig. 2 shows how to install the project into the device being protected. Essentially, the power supply lead of the device to be protected is now connected to the power supply lead of the project. The Co lead of the project becomes the new power supply lead of the device being protected. The Ao lead is used to power an alarm.

For example, to protect a car, connect the electronic ignition twelve volt lead to the power lead of this project. The Co lead is now connected to the twelve volt terminal of the ignition unit. The Ao lead can be connected to an alarm. This is clarified if you look at FIG. 2 and consider the electronic ignition module as the device being protected.

The home can be protected in a similar way if you consider an electric lock as the device being protected.

Conclusion

The project has provided me with peace of mind knowing that my classic sportscar is protected twenty-four hours a day. The project has worked flawlessly for ten years whether it is -30 degrees or +30 degrees outside. ❐



Completed Unit Installed in Author's Car

Parts List

R1-R6,R18:	2700 ohms
R7-R12,R14:	1000 ohms
R13,R15:	510 ohms
R16:	30,000 ohms
R17:	1,000,000 ohms
C1:	6.8 µF tantalum
C2:	0.01 µF ceramic disk
IC1:	LM 555 timer
Q1:	2N2222A
SCR1-SCR7:	C106D
D1-D2:	1N4148 or 1N914
K1-K2:	12 volt DPDT relay, Magnecraft W67RPCX-2
S1-S6:	normally-open switch
S7:	normally-closed switch
L1:	12 volt bulb

Available from Kamtronics, c/o Stephen Kamichik, 1460 Montcalm St., Laval, P.Q., H7W 1X1
Assembled and tested board: $49.95 plus $5.00 S&H (order #B1)
Assembled and tested in cabinet ready for installation: $69.95 plus $7.50 S&H (order #C1)
Additional installation information for most autos: $5.00 (order #I1)

FEATURE

Basic Electronics #3a

by Ron C. Johnson

Welcome back to the basics! Those of you who have been following this series know that this is 'boot camp' for semiconductor electronics — the place where you can get 'up to speed' on active components and circuits. If you are new to the series, don't worry: you can jump in here anywhere and find something useful and interesting to learn or to do.

Our last segment did a fast fly-past on transistors from the theoretical through applications. We looked at biasing, amplifiers, oscillators and some switching circuits. This month we'll build a couple of those circuits so that (if you are new to this) you can see what it takes to build a circuit from scratch. Hopefully you all have a DC power supply and a multimeter, (Did you build the simple power supply from the February issue?), and some of the tools needed to breadboard and build the circuits.

First, let's take another look at the phase shift oscillator from last month's article. (See Figure 1.) This is an easy project to build, (not so easy to design) which is inexpensive and useful as an audio signal source for testing circuits on your bench. While it will not replace a function generator it allows you to build something easy to start with. (Maybe we'll build a full fledged function generator later on.) Let's approach the subject from the perspective of how and why it was designed the way it was and then look at some construction details.

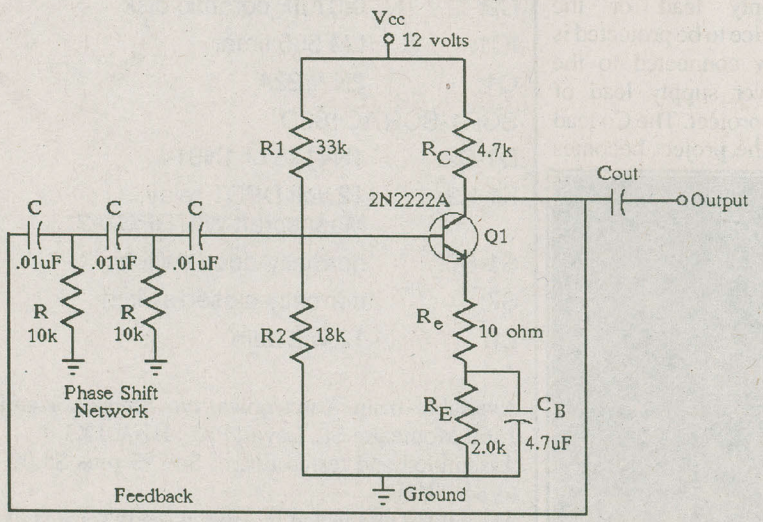


Figure 1. A Phase Shift Oscillator

What's in this oscillator? Let's review what we said last month. First, we saw how we could design a simple transistor amplifier stage using one transistor, a couple of capacitors, and some resistors. The circuit was set up to amplify an AC signal (for our purposes, in the audio range). The next step was to meet the criteria for oscillation which was to feed back the output signal of the amp to the input, in phase, with an overall gain of one. The amplifier inverts the signal, (180° shift), so the feedback network must invert it again to achieve the total 360° phase shift. The phase shift network, (three resistors and two capacitors) provides the phase shift at one particular frequency, but it also adds an attenuation of 1/29 so, to obtain an overall gain of one, the amplifier must have a gain of 29. (29 x 1/29 = 1) There is a formula for determining the frequency of oscillation of this circuit: $f = 1 / (\pi\sqrt{6RC})$. R is the value of both resistors and C is the value of all three capacitors in the phase shift network.

I wanted a frequency of oscillation of somewhere around 1 kHz but the exact frequency was not critical. Since there are two variables, (R and C), in the formula, some assumptions had to be made. I started by excluding capacitors above about 1 μF, especially electrolytics which usually have fairly high leakage and are bulky, both of which are undesirable in this situation. Also I ruled out very low values of

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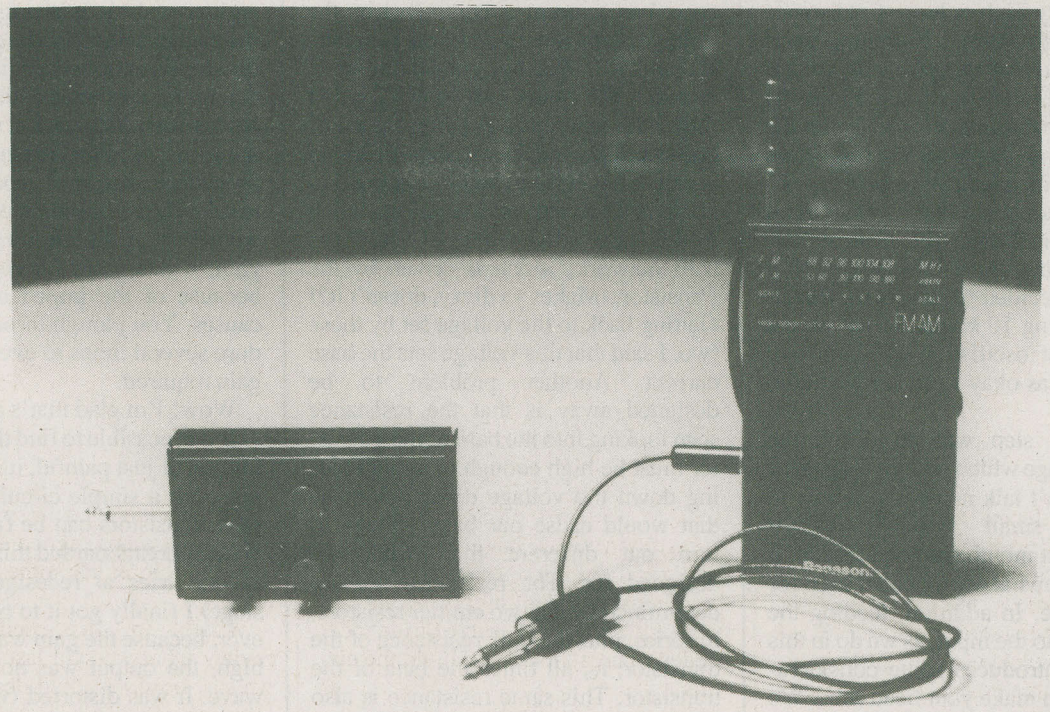

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capacitance because I knew it would result in very high values of resistance which I did not favour. I had some good quality .01 μF capacitors laying around so I decided to try them in the formula to start. Substituting in 1 kHz for the frequency and .01 μF for the capacitors I came up with a resistance of about 6.5 k ohms. It turned out that I was short on 6.8 k ohm resistors (the nearest EIA value) that day but I had lots of 10 k ohms so I decided to use them. Recalculating, using 10 k and .01 μF gave a frequency of oscillation of about 649 Hz which was okay for a simple audio oscillator.

The next step was to design an amplifier stage which will give a gain of 29. We didn't talk much about how to design a small signal transistor amplifier last month for good reason: it can get somewhat complicated even for a simple one. In addition, feeding the output back to the input, as we do in this oscillator, introduces some considerations that can make your head ache. We can't get into the whole story here but I'll give you enough to understand what the problems are.

The gain of a common emitter, voltage divider bias amplifier is determined by the ratio of the total collector resistance to the emitter resistance. (Gain = Rc/Re.) This is best proven using a page of mathematics showing how the emitter resistor controls the base current which controls the collector current, etcetera...a task we will avoid. However the design does centre around biasing the amplifier so that it will provide the gain of 29 even with its output connected back to its input through the phase shift network. This involves a series of calculations and approximations which start with the specifications (beta, for one), of the transistor you will use, DC operating point, AC operating point, the loading of the base voltage divider, input and output impedances, etcetera ad nauseam.

For those of you who already have a headache, you can skip this paragraph as I expand a bit on the design considerations. The DC operating point of the transistor is set by choosing the values for the voltage divider, R1 and R2. The DC operating point is the DC collector current and collector voltage of the transistor (which is the output) and sets the point around which any AC signal fluctuates. Collector current is controlled by base current and, in this case, base current is controlled by the voltage set by the values of the resistors, R1 and R2. Another consideration in choosing the values of R1 and R2 is that they influence the input impedance of the amplifier. When considered in parallel they have to be large enough to not load down the previous stage, which in this case is the output of the phase shift network, which is driven by the transistor. (Makes ya dizzy, doesn't it?) Getting back to the voltage set by these two: I said that this voltage sets the base current. Another problem to be designed away is that the resistance seen looking into the base of the transistor must be high enough to avoid loading down the voltage divider because that would cause our base voltage to turn out different than what we designed for. The resistance seen is determined by the two emitter resistors, in series, plus the bulk resistance of the transistor, r_e, all times the beta of the transistor. This same resistance is also in parallel with R1 and R2 and so influences the input impedance of the amplifier, as well. Here is where some of the problems come in: The collector resistance used in the gain formula is a parallel combination of the collector resistor and the impedance of the load connected to it. In this case the load connected is the phase shift network and the input of the amplifier. If the emitter resistor is changed to improve the gain or so that loading of the voltage divider does not occur, is also changes the input impedance which is part of the load, which changes Rc, which changes the gain. What this means is that whole procedure becomes something of a treadmill: every time a change is made anywhere in the circuit to change the gain, it has more far reaching affects because of the impedance changes it causes. You plough through the procedure several times to eventually get the gain required.

Wow! I'm glad that's over.

If it is possible to find this interesting, instead of just painful, it is that, designing even a simple circuit such as this, with transistors can be fairly complex. When I breadboarded this circuit, (after several tries at redesigning the gain stage) I finally got it to oscillate. However, because the gain was still a bit too high, the output was not a clean sine wave. It was distorted (very obviously not a clean sine wave shape when viewed on an oscilloscope). Distortion on a waveform is actually the presence of other frequencies, (usually harmonics of the fundamental), which can extend fairly high in frequency. (This became evident when the television in the next room came down with a case of

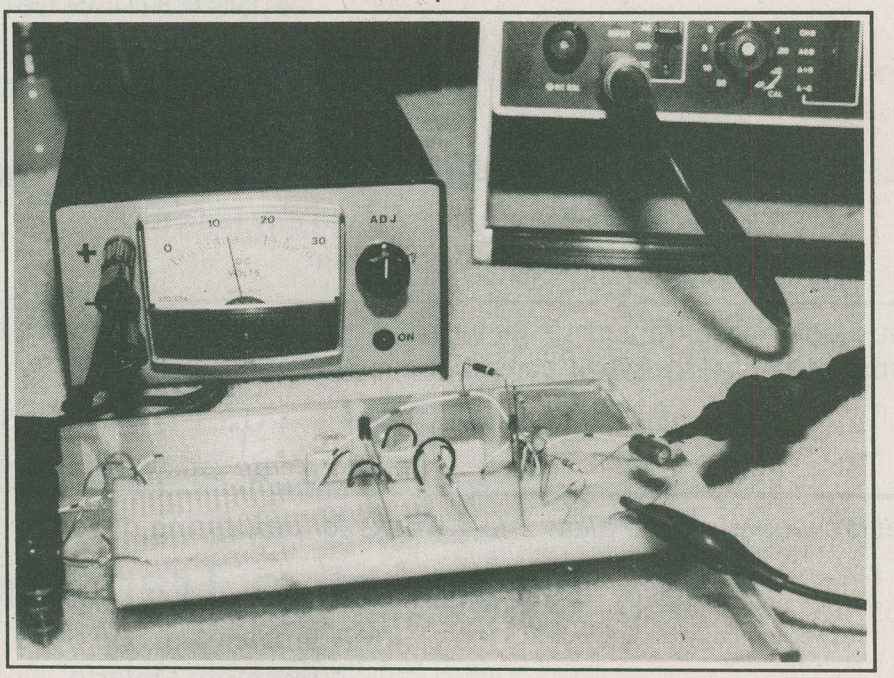

Figure 2

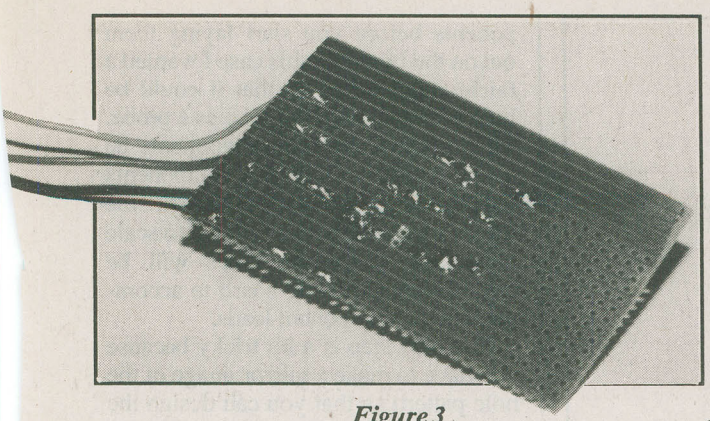

Figure 3

horizontal interference patterns every time the oscillator was turned on.)

If you are beginning to think that the fabulous, famous transistor we have heard so much about for years is not as wonderful as was originally thought, you are right. Transistor design is difficult and tedious - but it was an improvement over tubes and such. Overall, it is much simpler to design an amplifier using op amps or to build an oscillator using a chip produced for that purpose - and we'll get to that eventually in this series.

But, hey... isn't this fun?

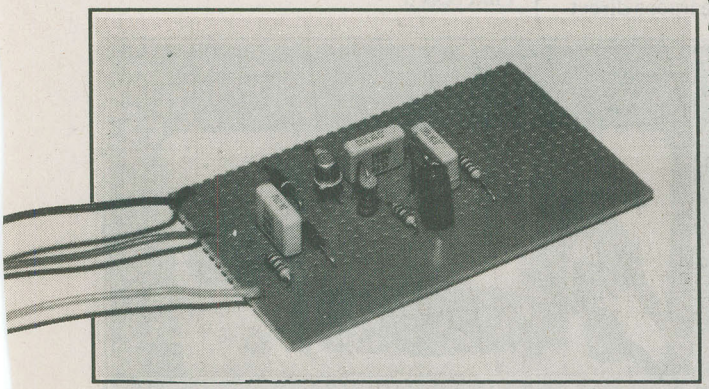

Figure 5

Well, let's build it anyway.

The components used in the circuit are shown on the schematic and are available at any electronics supplier. The transistor I used was a 2N2222A. This is a common small signal transistor in a TO-18, metal can package. You could use a variety of NPN transistors in this configuration, but make sure you know the pin configuration when you set it up as they differ somewhat.

(Here is the most useful hint I'll give you in this series: Get yourself an ECG Semiconductors Master Replacement Guide from an electronic supplier who handles Sylvania components. It is a very useful reference for a wide range of parts, specifications, pin configurations, etc. It is also a good cross reference from one manufacturer to another.)

But, back to the transistor we are using. If you cross reference the 2N2222A with the ECG book it goes to an ECG123A. The specs show the power dissipation as .500 watts or one-half watt. We'll talk about specs in another articles but, for now, as long as you don't load the output of the oscillator down too much in use you should not have any problems. If you do damage the transistor, it's cheap to replace anyway. The other spec we were concerned about in designing the amp was beta, or h_{FE}. This is given as 200 typical. We minimized the amplifier's dependency on this by bypassing only one part of the emitter resistance, R_E, with capacitor, C_B. R_e, which is unbypassed, swamps out most of the amplifier's dependency on the beta of the transistor. Other specs were used to make sure that maximum voltage and currents were not exceeded.

You could replace the 2N2222A with a number of other transistors. An ECG123AP, 2N3904 or 2N4401 should work with no problems. These are similar to the 2N2222A but come in a plastic TO-92 package and have lower power dissipation specs.

Figure 2 shows a photograph of the breadboarded circuit, powered by a twelve volt power supply and the components of the oscillator. A breadboard such as this is practically indispensable for testing out projects, is easy to use, and allows you to make changes easily. For example, on the breadboard I replaced the 10 ohm unbypassed emitter resistor with a potentiometer. Adjusting the pot allowed me to vary the gain to see at what point the circuit would begin to oscillate. I then measured the value of the pot and replaced it with a resistor. (I know, it's cheating...you're suppose to be able to predict all that on paper ... don't tell my students.)

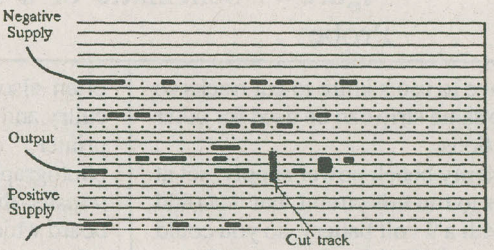

Figure 4. Solder side layout of Oscillator

After I got the circuit operating on the breadboard I found a scrap of Veroboard and mounted the components on it. (Figures 3 and 4 show the copper side, Figures 5 and 6 show the component side.) Veroboard has parallel copper tracks and a matrix of predrilled holes to mount the components. The layout shown may help you to mount the components but actually this circuit is relatively simple and you would have no trouble setting up the layout yourself. Be careful when soldering to avoid solder splashes that will short out parts of the circuit. You

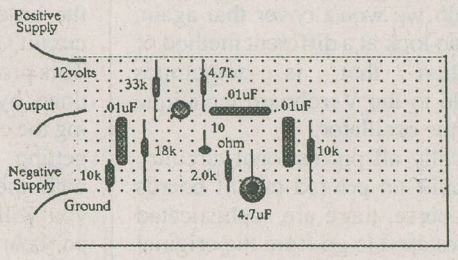

Figure 6. Component layout for Oscillator

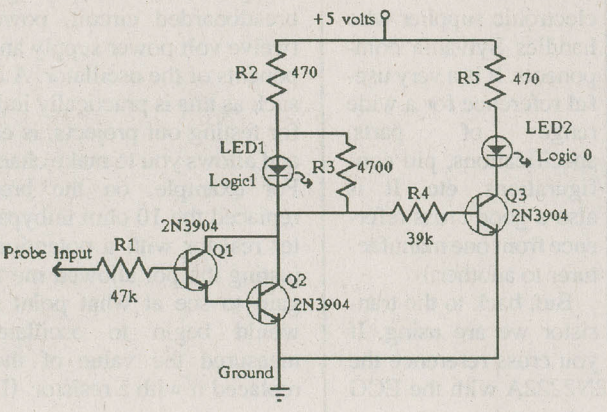

Figure 7. Schematic of a Logic Probe

may have to use a knife to cut tracks so that the same strip can be used for other connections.

I used my bench power supply, set at 12 volts to run this circuit, but it should work with a 9 volt battery, so you could build the whole thing into a small box or tube and use it as a signal probe. The circuit only has three connections: plus and minus power supply and output.

The other circuit we saw last month was a logic probe. Shown in Figure 7, the logic probe uses three small signal transistors as switches to sense the logic level (0 or 1, about zero volts or about 5 volts) and to switch on and off two light emitting diodes which indicate which logic level is present at the input. This can be a useful piece of test equipment when checking digital circuits, especially when an oscilloscope is not available. Again, this circuit is small and simple to build, and since it derives its power from the circuit under test, no power supply needs to be built. It can also be built into a small box or tube making it handy as a test probe. Since we went through the circuit operation last month we won't cover that again, but we can look at a different method of construction that is sometimes preferable to the Veroboard technique used for the oscillator.

Practically all professional circuitry is now built on printed circuit boards and, of course, there are sophisticated techniques used to go from the original design to a finished printed circuit board. Computer programs which help in the schematic design process can often also be used to lay out the circuitry and then generate artwork with a printer or plotter. From there photographic techniques are used to transfer the design onto a copper clad board which, when etched using chemicals, becomes the final circuit board.

There are kits available which can set you up to use this process with some variations. You can use direct artwork transfers which bypass the photography allowing you to layout the traces directly on the copper clad board and then etch it. The cheap and dirty approach, (which works satisfactorily for simple circuits), is to directly draw the traces onto the copper using a non-water soluble felt pen. That's what I used for the prototype of the logic probe.

Figure 8 is a photograph of the breadboarded circuit, a layout pattern and the un-etched printed circuit board itself. This procedure is best done by breadboarding the circuit first and getting it working with the components you will use on your pc board. That way you will know the physical sizes and shapes of all components before you start laying them out on the board. In this case I wanted a fairly small board so that it could be built into some kind of tube as a probe. This required that the components be close together. Once the components are laid out properly a component side layout pattern should be drawn to scale indicating where the holes will be drilled through the pc board to accommodate the component leads.

The next step is a bit tricky because you have to make a mirror image of the hole pattern so that you can design the layout of the copper or solder side of the pc board. See Figure 9. (Sounds simple but this usually causes some problems.) Once you have the pattern of holes for the solder side the designing of the track layout to connect the components leads as in the original circuit is done. Sometimes you are forced to go back and change the component layout to allow interconnections. You may even need to add a jumper wire to the design of the top of the board to facilitate the connections. (In this case it was simple enough that no jumpers were necessary.) When you finally have the design laid out you will draw the circuit onto the copper clad board.

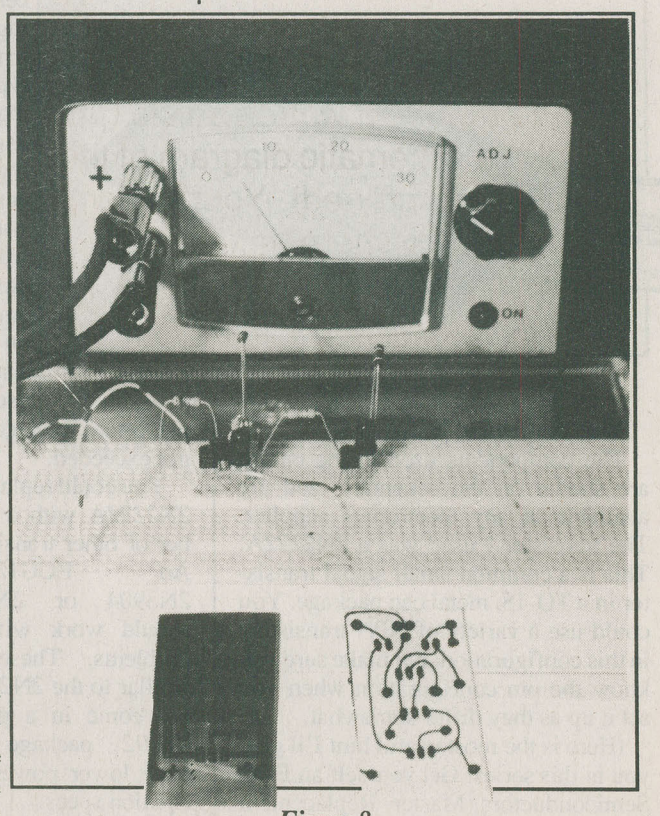

Figure 8

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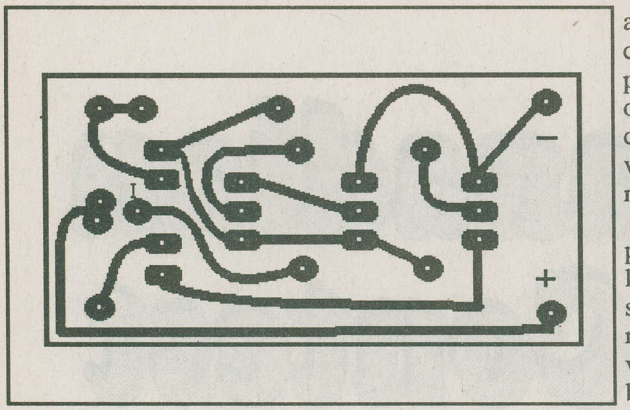

Figure 9. PC Layout for Logic Probe

Copper clad board can be obtained from an electronic supplier in a variety of qualities. The thickness of the copper can vary with heavier boards being less likely to lift the tracks and pads when you solder to them. The board itself comes in epoxy or phenolic, primarily. Epoxy is more expensive and stronger while phenolic is less expensive but brittle and may break if dropped. I prefer epoxy but for most applications phenolic is acceptable.

Before you start drawing pretty traces on the copper side of the board the copper must be cleaned of all oxidization. If you don't the etchant you use later will not work evenly. One way to do this is by scouring the surface with steel wool. A scouring pad and fine sand works well but most people will not have easy access to it. In a pinch fine sandpaper would be acceptable but may be difficult to maintain an even amount of abrasion causing too much copper to be removed. The object is to make the copper look shiny without taking off too much of it.

The next step is to place the printed circuit layout over the copper side of the board and mark where the holes will be drilled. This can be done by lightly centre punching each pad drawn on the layout, which leaves an indentation to indicate the layout and provide a dimple for drilling later.

You are now ready to draw the circuit traces on the board. The main concerns here are to avoid getting fingerprints or other contaminants on the board (which may interfere with the etchant) and to draw the circuit traces as cleanly as possible leaving enough space between them so the etchant can separate them. The whole procedure is a bit tricky at first but you'll get onto it with no major problems. Remember: Use a fine tipped felt pen of the type that is non-water soluble. Pens sold specifically for this use are available at electronic suppliers.

Once the layout is drawn and dry, the board can be etched, and should be within the next few hours as the copper will begin to oxidize if you don't. There are a couple of etchant chemicals which are obtainable from your local electronic supplier. I use ferric chloride solution because, though it is slow, it will etch fairly well at room temperature and is relatively safe to use. (When you buy this obtain a Material Safety Data Sheet and read it to familiarize yourself with safe handling procedures, etc.) To use the etchant just pour it in a shallow tray, drop the pc board in with the copper side up and move it around every few minutes. Etching may take fifteen or twenty minutes depending on how clean your board is and how much copper must be etched off. The areas where you have drawn traces should be impervious to the etchant unless you leave it in too long. A bit of experimentation should perfect your technique.

When you are done etching wash the board under the tap (again, refer to the MSDS for safe handling instructions of the etchant). From here you can use the steel wool to scrub off the ink and your board is ready to be drilled, stuffed and soldered. Figure 10 shows the component layout for the board.

We'll talk more about printed circuit board techniques in subsequent articles as we get into more complicated layouts requiring photographic techniques. In the meantime this one is simple and yet useful and inexpensive if you have never tried it before.

That's all for this time. Watch for some more theory on semiconductors coming up. ❐

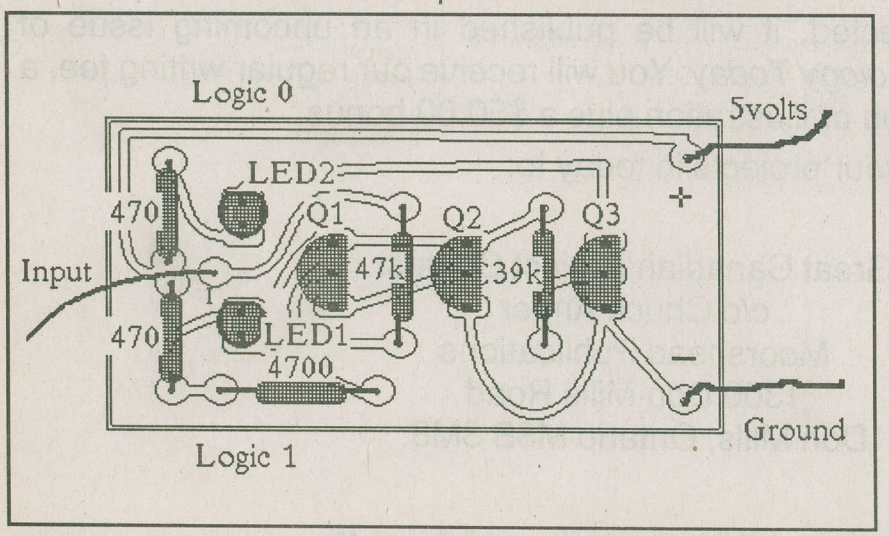

Figure 10. Component Layout for Logic Probe

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Mike..W4AD... The Dog...

by Bob Havens, VE3IYO (VE3MPS)

Since the purpose of this instalment was to inform you about the cost of Amateur Operation I thought I would share this with you. While on the air since the last time I must admit the most interesting contact for myself and the students was with W4AD..THE DOG. Mike was operating on the 20 metre band and he was stirring up controversy with his somewhat questionable CQ call. Mike was calling for only those people who were not collecting social benefits. He was referring to retirees collecting the 'Old Age Pension'. His reason was that they would not be very interesting contacts and Mike was also complaining about some statistics he had just read regarding the average HAM OPERATOR. Apparently this person is a white male 55 years of age. He was not doing anything illegal but neither would you if you were to air your views on abortion or Sunday shopping. He was striking interest and anger in those who heard his call. We answered and had a short QSO (conversation) with him. Afterwards, he commented that he did not want to talk with foreigners and no retirees. The students with me that day were 3 grade six girls. When he discovered they were in the room he asked to have them talk with him. It actually turned out to be a most interesting lunch hour. Mike works in the broadcast industry and had just spent 5 weeks in Saudi-Arabia. He was able to relate very well to the girls and they handled all questions on their own. They asked and received a QSL card from him and it was on that card that he had printed W4AD...THE DOG. We are still trying to figure the nickname.

Operators like Mike are rare but he had his point. We need new blood in this hobby. We need you. That is why the D.O.C. has changed the regulations and made it easier to obtain your qualifications. In case you missed the original address and would still like to get a copy of the CARF book to study I'll give out the address at the end of this piece.

On The Air

The main point we promised to cover today was the cost and setup of your amateur equipment. Since it has been 14 years from the time I became licensed I thought it was a good idea to contact two HAMS who were licensed just last year. Mark VE3SDA and Al VE3DXS gave me a rundown of what equipment they purchased and what it cost for them to get on the air.

Mark was an amateur who took a course at a local college near Mitchell and studied through the winter of 1990 and became licensed in the early spring of that year. He did this so when the regulations changed in the fall he would be given ADVANCED status automatically without writing the ADVANCED examination. This was part of the regulation changes. All amateurs who received their license as a beginner under the old rules had to pass BOTH the technical exam and morse code test. Therefore, when the BASIC QUALIFICATION was introduced requiring no code exam they were deemed as overqualified and GRANDFATHERED into the ranks of the ADVANCED. Because of this, Mark started with an HF rig. This is for the bands below 30 MHZ. As a beginner you will not be allowed to use this frequency until you pass at least a 5 WPM code test. However, many hams and future amateurs purchase a receiver to practise code and listen to world calls. Mark bought a used Drake transceiver for $350. He bought a trap dipole kit for his antenna. Some soldering was required and the cost was $120 and about $100 for coax. If you just buy the traps and scrounge the wire cut this price in half. I even bought a used set of traps some 6 years back for $10. For 1/4 this price you might be able to wind your own traps. Nice thing about this hobby - lots of room for the technician! He purchased a new key for $50 and was on the air. Moderate keys for $25 are available and once again used equipment is plentiful. He started making contacts on 40 and 80 metres. It was not until later that summer that Mark decided to purchase a 2 metre rig. He bought a Kenwood TM231A rig. It has lots of power and comes complete with phone patch and magnetic antenna for $600. This is mainly for mobile operation but any mobile rig can be brought indoors. In fact, I STRONGLY recommend you do. Theft rate is up some 400% since I joined the hobby. More thieves are educated as to the worth of these radios. Just a caution here, if you do purchase a rig used. Check it out carefully and do your part

See **Ham**, *page 44*

Industry News

AERONAUTICAL SATCOMS TAKES OFF

A phone call to London from a Gulfstream aircraft operating in southern United States on 2 November, 1990, eliminated the last communications vacuum for mankind on the move.

Dramatic advances in mobile satellite communications technology in the 1980s have meant that there is nowhere on land and sea where people cannot communicate with the rest of the world. Apart from limited areas where direct air-to-ground radio telephone services are provided, passengers and crew in aircraft remained the only people who were regularly out of touch with the rest of the world.

Today, mobile satcoms are available to aircraft worldwide. Between December 1990 and March 1991, Inmarsat, the global operator of satellites for mobile communications, licensed three ground earth stations (GESs) to use its systems for aeronautical voice communications, completing a network that, for the first time, provides commercial telephone services for aircraft worldwide.

Inmarsat, a 64-member-country cooperative, already provides mobile satellite communications for ships at sea and land-based users worldwide. More than 14,600 of Inmarsat's satellite terminals are now in use for telephone, telex, electronic mail, facsimile and data communications.

After extensive trials and demonstrations that began in 1988, the start of the present aircraft telephone service marks the first phase of commercial availability of Inmarsat's new aeronautical system. Commercial data services will soon follow.

An International Endeavour: The first GES to come on line, at Goonhilly, Cornwall, is operated by British Telecom International (BTI). The first aircraft to be fitted with satcoms equipment is a Gulfstream IV, operated by Gulfstream Aerospace Corporation, based in Savannah, Georgia in the U.S. The airborne equipment comprises avionics and a special fin-mounted antenna made by Racal Avionics Ltd. of the U.K. Two more GESs have now been authorized, one at Eik operated by Norwegian Telecom and another in Singapore operated by Singapore Telecom, extending the coverage of the GESs worldwide.

Worldwide transoceanic communications are provided through three coverage zones — the Atlantic Ocean (East), the Pacific and the Indian ocean regions — each served by one operational Inmarsat satellite and several back-ups. The current configuration of GESs in operation provides one station for every coverage region — Goonhilly for the Atlantic region, Singapore for the Pacific and Eik for the Indian ocean regions. A fourth region, Atlantic Ocean (West), is expected to come into operation this year, providing overlapping coverage for the Atlantic region and across the Americas into the Pacific. Each GES acts as a gateway into the world's telecom networks. Calls made from the aircraft are beamed to a GES via Inmarsat's satellites and then channelled through national or international telecom networks to anywhere in the world. Depending on which coverage region an aircraft is flying in, the communications are routed through a GES in that region. As more GESs are commissioned, the system will allow a choice of stations for routing the communications.

The licensing of the current GESs capped years of collaborative research and development by London-based Inmarsat and aeronautical organizations throughout the world. The efforts have been aimed at bringing the benefits of global satellite communications to the aeronautical community that has traditionally relied on the inadequate HF radio system.

The result has been the evolution of a service that is standardized throughout the world, meets the operational requirements of international airlines and provides for functional avionics and antenna equipment that permit a full range of cost-effective services. Global aeronautical satcoms are now reality.

The Changing Profile: Since that first Gulfstream IV, about two dozen other corporate aircraft have been fitted with satellite communications equipment. Several passenger airlines are examining the possibility of outfitting entire fleets. As more and more aircraft are fitted out with satellite telephones, fundamental changes to the concept of passenger services are inevitable.

Travellers will quickly come to regard an airline which offers satellite passenger phone services as an extension of their office, offering them the same capability to conduct business and make contacts as they enjoy on ground. Passengers will increasingly demand other communications services such as facsimile, which, market experts say, will soon be as common as in-flight movies.

Some airlines are studying the possibility of in-cabin data terminals for re-bookings, hotel and car rental reservations and even banking and financial services. With this, "business" class could become a more accurate description as a place where businessmen can continue to work from the air as easily as they do from their offices on land.

For airlines, global passenger voice communications would be an additional source of revenue. Satellite communications could also be a part of the airlines' marketing strategies. Although there may not be an increase in the total passenger market, passengers will be attracted to fly on an airline offering satcoms.

Satcoms for Airline Operations: While passenger communications services may capture public imagination and an increased market share for an

See **Industry**, *page 43*

FEATURE

Babani Book of the Month

Welcome to our feature, the Babani Book of the Month. In each issue we will present an excerpt from a particular Babani Book. This month we are featuring *An Introduction to Radio DXing* by R. A. Penfold, book number BP91. To order this, or any Babani book, fill out the order form at the end of this article and send it in with the appropriate payment.

Notch Filter

A common form of interference on the low frequency bands, and one that can be very troublesome when topband DXing, is that of heterodyne tones. These are caused by carrier waves reacting with the BFO or CIO signal to produce a continuous audio output tone.

This type of interference can be eliminated using a notch filter operating in either the IF or audio stages of the receiver. A few receivers have a built in notch filter, but it is not a common feature of communications receivers. However, it is quite easy to add an audio notch filter at the audio output of a receiver, and the improvement in intelligibility that can be obtained by using such a filter (when a strong heterodyne is present) is very considerable.

The circuit diagram of an add-on audio notch filter is shown in Figure 17, and this can be tuned from a little under 100Hz to beyond the upper limit of the audio frequency range. The degree of attenuation provided when the filter is properly adjusted is in excess of 80dB, and is sufficient to render any heterodyne inaudible. Of course, the filter only works at a single frequency, and any harmonics of the heterodyne caused by distortion in the various stages of the receiver will not be significantly affected. However, this should not be a problem as most receivers have only low levels of harmonic distortion.

The circuit is quite conventional, and TR1 is used as a phase splitter with out-of-phase signals appearing at its collector and emitter terminals. In effect, TR1 operates as a common emitter stage from its base to its collector, giving an inverted signal at its collector. It operates as an emitter follower stage from its base to its emitter, giving no phase change between these two terminals. The voltage gain from the base to the emitter is roughly unity, as is normally the case for an emitter fol-

Continued...

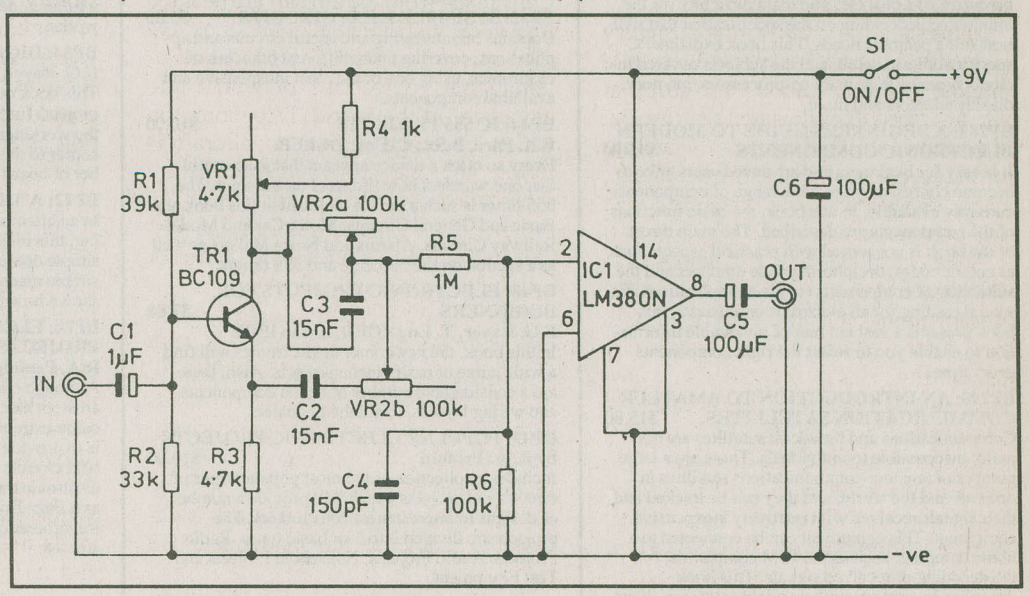

Fig. 17. The circuit diagram of the audio notch filter

Babani Books

New Releases

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This book is primarily intended as a follow-up to BP239, and also should be of value to anyone who already understands the basics of voltage testing and simple component testing.

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BP285: A BEGINNERS GUIDE TO MODERN ELECTRONIC COMPONENTS $15.80
It is easy for beginners and advanced users alike to become confused by the wide range of components currently available. In this book, the basic functions of the components are described. The main thrust of the book is concerned with practical aspects such as colour codes, deciphering code numbers and the suitability of components for given applications. Essential reading for all electronic enthusiasts, this book presents a vast amount of invaluable information to enable you to select the right components every time.

BP290: AN INTRODUCTION TO AMATEUR COMMUNICATION SATELLITES $15.80
Communications and broadcast satellites are normally inaccessible to individuals. There are a large number of amateur communications satellites in orbit around the world, and they can be tracked and their signals received with relatively inexpensive equipment. This equipment can be connected to a home computer such as the IBM compatible, for the decoding of received signals. This book describes several currently available systems, their connection to an appropriate computer and how they can be operated with suitable software.

BP292: PUBLIC ADDRESS LOUDSPEAKER SYSTEMS $15.80
The loudspeaker system is a critical part of any public address installation. All too often it is woefully inadequate, resulting in poor intelligibility and unnatural reproduction. We here examine the various systems and their drawbacks, and describe LISCA, the Line-Source Ceiling Array. This gives astonishing clarity, even coverage, reducing feedback, natural source location and even a pseudo-stereo effect. It promises to be the ultimate system for small to medium sized halls. Full step-by-step construction and installation details are given.

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BP— ELEMENTS OF ELECTRONICS — AN ON-GOING SERIES $11.80 EACH
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F.A. Wilson, C.G.I.A., C.Eng.,
Although written for readers with no more than ordinary arithmetical skills, the use of mathematics is not avoided, and all the math required is taught as the reader progresses. Each book is a complete treatise of a particular branch of the subject and therefore, can be used on its own with one proviso, that the later books do not duplicate material from their predecessors, thus a working knowledge of the subjects covered by the earlier books is assumed.

BP62: BOOK 1.
This book contains all the fundamental theory necessary to lead to a full understanding of the simple electronic circuit and its main components.

BP63: BOOK 2.
This book continues with alternating current theory without which there can be no comprehension of speech, music, radio, television or even the electricity utilities.

BP64: BOOK 3.
Follows on semiconductor technology, leading up to transistors and integrated circuits.

BP77: BOOK 4.
A complete description of the internal workings of microprocessor.

BP89: BOOK 5.
A book covering the whole communication scene.

BP78: PRACTICAL COMPUTER EXPERIMENTS $5.25
The aim of this book is to enable the reader to simply and inexpensively construct and examine a number of basic computer circuit elements and gain a fuller understanding of how the computer chip works.

BP84: DIGITAL IC PROJECTS $7.80
F.G. Rayer, T. Eng. (CEI), Assoc.IERE.
This book contains both simple and more advanced projects for the reader developing a knowledge of the workings of digital circuits. To help the newcomer to the hobby the author has included a number of board layouts and wiring diagrams.

BP72: A MICROPROCESSOR PRIMER $5.25
In an attempt to give painless approach to computing, this inexpensive book will start by designing a simple computer and then the short-comings of this simple machine will be discussed and the reader is shown how these can be overcome.

BP74: ELECTRONIC MUSIC PROJECTS $10.00
R.A. Penfold
Although one of the more recent branches of amateur electronics, electronic music has now become extremely popular. The purpose of this book is to provide the constructor with a number of practical circuits for the less complex items of electronic music equipment, including such things as a Fuzz Box, Waa-Waa Pedal, Sustain Unit, Reverberation and Phaser Units, Tremolo Generator, etc.

BP85: INTERNATIONAL TRANSISTOR EQUIVALENTS GUIDE $9.00
Designed to help the user find possible substitutes for a popular user-oriented selection of modern transistors and includes devices produced by over 100 manufacturers.

BP92: ELECTRONICS SIMPLIFIED - CRYSTAL SET CONSTRUCTION $5.25
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An unusual and fascinating chart that is highly recommended to all those interested in electronics and which will hopefully pay for itself many times over, by enabling the reader to use IC's that might otherwise have been scrapped.

BP103: MULTI-CIRCUIT BOARD PROJECTS by R.A. Penfold $7.80
This book allows the reader to build 21 fairly simple electronic projects, all of which may be constructed on the same printed circuit board. Wherever possible, the same components have been used in each design so that with a relatively small number of components and hence low cost, it is possible to make any one of the projects or by re-using the components and P.C.B. all of the projects.

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Features a wide range of constructional projects which make use of op-amps including low-noise, low distortion, ultra- high input impedance, high slew-rate and high output current types.

BP110: HOW TO GET YOUR ELECTRONIC PROJECTS WORKING $7.80
R.A. Penfold
We have all built circuits from magazines and books only to find that they did not work correctly, or at all, when first switched on. This book will help the reader overcome these problems by indicating how and where to start looking for many of the common faults that can occur when building up projects.

BP111: AUDIO $14.00
Covers a wide range of material from analysis of the sound wave, mechanism of hearing, acoustics, microphones and loudspeakers, amplifiers, and magnetic disc recording.

BP115: THE PRE-COMPUTER BOOK $5.85
Aimed at the absolute beginner with no knowledge of computing, this entirely non-technical discussion of computer bits and pieces and programming is written mainly for those who do not possess a microcomputer but intend to one day own one.

BP118: PRACTICAL ELECTRONIC BUILDING BLOCKS – BOOK 2 $7.60
R.A. Penfold
This sequel to

BP117 is written to help the reader create and experiment with his own circuits by combining standard type circuit building blocks. Circuits concerned with generating signals were covered in Book 1, this one deals with processing signals.

BP121: HOW TO DESIGN AND MAKE YOUR OWN PCBs $5.85
The purpose of this book is to familiarize the reader with both simple and more sophisticated methods of producing printed circuit boards. The book emphasizes the practical aspects of printed circuit board designs and construction.

BP122: AUDIO AMPLIFIER CONSTRUCTION $6.75
A wide circuits is given, from low noise microphone and tape head preamps to a 100W MOSFET type. There is also the circuit for 12V bridge amp giving 18W. Circuit board or stripboard layout are included. Most of the circuits are well within the capabilities of even those with limited experience.

BP125: 25 SIMPLE AMATEUR BAND AERIALS $5.85
This book describes how to build 25 amateur band aerials. The designs start with the simple dipole and proceed to beam, triangle and even a mini-rhombic.

BP127: HOW TO DESIGN ELECTRONIC PROJECTS $9.00
Although information on stand circuits blocks is available, there is less information on combining these circuit parts together. Practical examples are used and each is analyzed to show what each does and how to apply this to other designs.

BP130: MICRO INTERFACING CIRCUITS BOOK 1 $9.00
Aimed at those who have some previous knowledge of electronics, but not necessarily an extensive one, the basis of the book is to help the individual understand the principles of interfacing circuits to microprocessor equipment.

BP131: MICRO INTERFACING CIRCUITS – BOOK 2 $9.00
Intended to carry on from Book 1, this book deals with practical applications beyond the parallel and serial interface. Real world interfacing such as sound and speech generators, temperature, optical sensors, and motor controls are discussed using practical circuit descriptions.

BP136: SIMPLE INDOOR AND WINDOW AERIALS $7.00
People living in apartments who would like to improve shortwave listening can benefit from this book on optimizing the indoor aerial.

BP155: INTERNATIONAL RADIO STATIONS GUIDE $9.00
An invaluable aid in helping all those who have a radio receiver to obtain the maximum entertainment value and enjoyment from their sets.

BP174: MORE ADVANCED ELECTRONIC MUSIC PROJECTS $12.00
Complementing Book PB74, Electronic Music Projects,

BP174 provides projects, such as a flanger, a phaser, mini-chorus and ring modulators, percussion synths, etc. Each project has an introduction circuit diagram and constructional notes.

BP179: ELECTRONIC CIRCUITS FOR THE COMPUTER CONTROL OF ROBOTS $12.00
The main stumbling block for most would-be robot builders is the electronics to interface the computer to the motors, and the sensors which provide feedback from the robot to the computer. The purpose of this book is to explain and provide some relatively simple electronic circuits which bridge the gap.

BP180: ELECTRONIC CIRCUITS FOR THE COMPUTER CONTROL OF MODEL RAILWAYS $9.00
Shows how home computers can easily be applied to the control of model railroads and other quite sophisticated control. A variety of projects are discussed as well as circuits for train position sensing, signal and electric points control, etc.

BP185: ELECTRONIC SYNTHESIZER CONSTRUCTION $9.00
With this book a relative beginner should be able to build, with a minimum of difficulty and at a reasonably low cost, a worthwhile monophonic synthesizer and also learn a great deal about electronic music synthesis in the process.

BP192: MORE ADVANCED POWER SUPPLY PROJECTS $8.00
Robert Penfold.
A companion to BP76, this book covers switched mode supplies, precision regulators, tracking regulators, computer- controlled supplies, etc.

BP225: A PRACTICAL INTRODUCTION TO DIGITAL ICs $7.00
This book deals mainly with TTL type chips such as the 7400 series. Simple projects and a complete practical construction of a Logic Test Circuit Set are included as well as details for a more complicated Digital Counter Timer project.

BP233: ELECTRONIC HOBBYIST HANDBOOK $15.00
A single source of easily located information: colour codes, pinouts, basic circuits, symbols, etc.

BP239: GETTING THE MOST FROM YOUR MULTIMETER $9.00
This book is aimed at beginners in electronics. Using the simple component and circuit testing techniques in this book the reader should be able to confidently tackle servicing of most electronic projects.

BP240: REMOTE CONTROL HANDBOOK $12.00
Includes remote control systems, transmission links, digital electronics, methods of control, decoders, etc.

BP245: DIGITAL AUDIO PROJECTS $11.80
This book takes a look at the basic principles involved in converting an audio signal into digital form and then converting it back to an analogue signal again. It also contains practical circuits for constructors to build and experiment with.

BP247: MORE ADVANCED MIDI PROJECTS $11.80
This book includes circuits for a MIDI indicator, THRU box, merge unit, code generator, pedal, programmer, channeliser and analyzer.

BP248: TEST EQUIPMENT CONSTRUCTION $11.80
This book describes in detail how to construct some simple and inexpensive, but extremely useful, pieces of test equipment.

BP249: MORE ADVANCED TEST EQUIPMENT CONSTRUCTION $14.00
This book carries on from BP 248, TEST EQUIPMENT CONSTRUCTION, describing some slightly more advanced projects for readers who have a certain amount of experience at project construction.

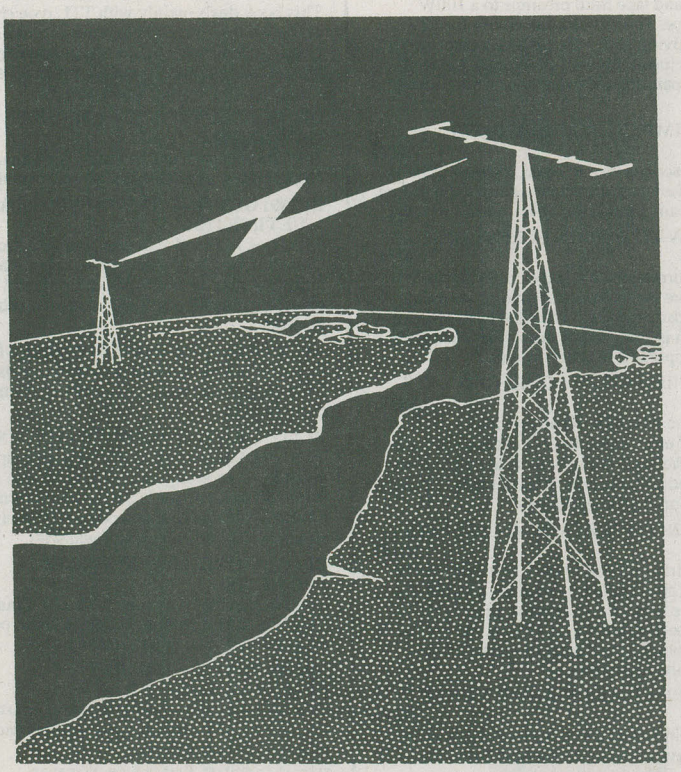
BP251: COMPUTER HOBBYISTS HANDBOOK $23.80
This book provides a range of useful reference material in a single source so that it can be quickly and easily located. The subjects covered include microprocessors and their register sets; interfacing serial, parallel, monitor, games and Midi ports; numbering systems; Midi codes; operating systems and computer graphics.

BP256: AN INTRODUCTION TO LOUDSPEAKERS AND ENCLOSURE DESIGN $11.80
This book explores many types of enclosures and drive units. Crossover units are also explained, the various types, how they work, the distortions they produce and how to avoid them.

BP257: AN INTRODUCTION TO AMATEUR RADIO $14.00
Topics covered in this book include the basic aspects of the hobby, such as operating procedures, jargon and setting up a station. Technical topics include propagation, receivers, transmitters and aerials etc.

An Introduction to Radio DXing

R.A. PENFOLD



lower. Although a common emitter amplifier normally has a fairly high voltage gain, this is not the case here due to the negative feedback introduced by R3, and this results in the two output signals being of roughly the same amplitude. The amplitude of the signal at the collector terminal can be varied by means of VR1.

The two outputs are fed to a Wien network which consists of VR2, C2 and C3. At a certain frequency there will be an identical phase shift through each section of the Wien network (one section being formed by VR2a plus C3, and the other by VR2b and C2), and the two outputs will have a cancelling effect on one another. VR1 is adjusted so that the two signals precisely cancel one another out at this frequency, thus producing the required narrow notch of high attenuation in the frequency response of the circuit.

VR2 is the tuning control, and is adjusted to null the interfering heterodyne. To optimise the attenuation of the heterodyne VR1 and VR2 should be adjusted in turn until it has been reduced to an insignificant level.

The output from the Wien network is at a fairly high impedance, and a buffer amplifier is needed to match this to a loudspeaker or a pair of headphones. A simple amplifier using an LM380N IC (IC1) is used to

provide this buffering. The gain of the LM380N is fixed at a nominal level of 50 times (34dB) by an internal negative feedback circuit, and this is rather higher than is required here. R5

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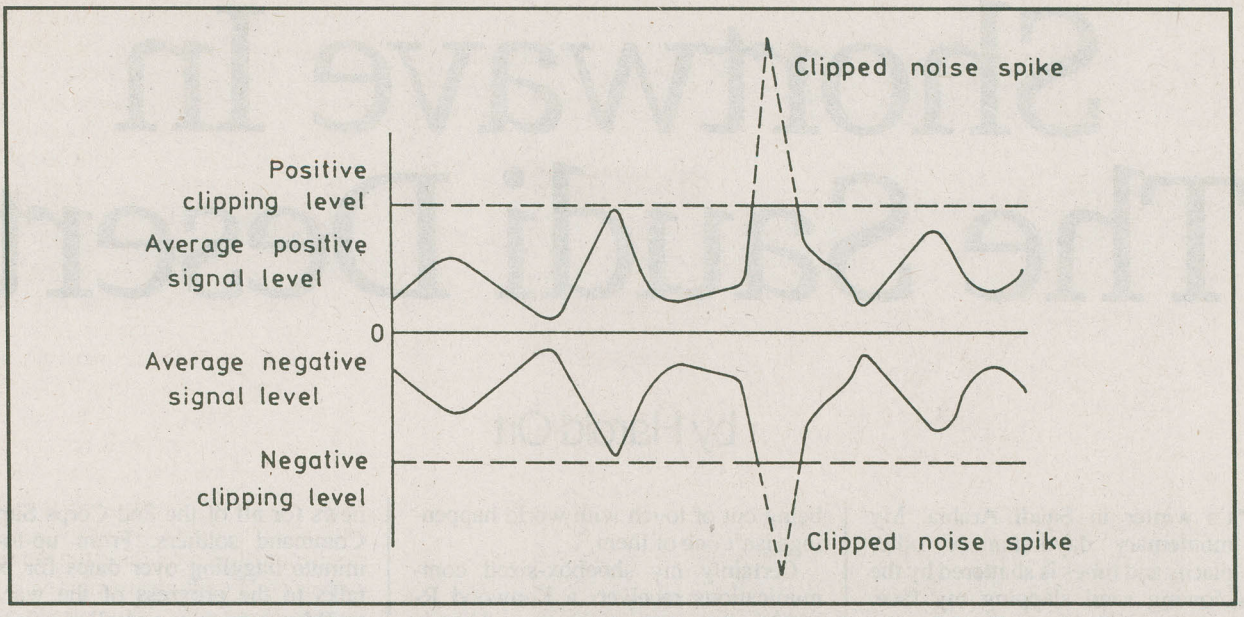

Fig. 16. The noise limiter attenuates large noise spikes but not the wanted signal.

and R6 are used as an attenuator which reduces the voltage gain of the circuit to a more appropriate level, and R5 also boosts the input impedance of the amplifier. The overall voltage gain of the unit is a little more than unity. C4 rolls off the high frequency response of the circuit and this helps to give good stability.

S1 is the on/off switch and C6 provides supply decoupling. The current consumption of the circuit is approximately 10mA, but the LM380N has a class AB output stage, and the current consumption will therefore be somewhat higher when the unit is driving a loudspeaker at fairly high volume.

Since the unit attenuates a narrow band of frequencies rather than just affecting one frequency, the unit can sometimes be used to good effect on types of interference other than heterodynes. I order to be effective though, the interference must be concentrated mainly over a fairly narrow band of frequencies (which does quite often seem to be the case).

The circuit can be used to drive any normal type of loudspeaker or headphones, and its input is taken from the headphone socket of the receiver.

Parts List

Resistors, all ¼ watt 5%

R1	39k
R2	33k
R3	4.7k
R4	1k
R5	1M
R6	100k
VR1	4.7k lin. carbon pot.
VR2	100k + 100k lin. carbon pot.

Capacitors

C1	1µF 10v
C2, C3	15nF plastic foil
C4	150 pF ceramic
C5, C6	100 µF 10v

Semiconductors

IC1	LM380N
TR1	BC109 (or ECG 123A or Radio Shack cat. # 276-2009)

Miscellaneous

Case, Switch — SPST toggle, component panel 9 Volt battery, input and output sockets, wire, solder, etc. ❐

FEATURE

Shortwave In The Saudi Desert

by Harold Ort

It's winter in Saudi Arabia. My momentary daydream of other places and times is shattered by the blowing sand slapping my face. That short walk from the runway through a small sandy area and the subsequent bus ride to our tactical area in the middle of nowhere will stick in my mind forever. I've filed the picture of our new desert 'home' next to the word 'desolate.'

No doubt about it, our site is remote. The long convoy from the port into the desert ended in an area that looks no different than anywhere else. The horizon is infinity and blowing sand is everywhere. Now I know what Neil Armstrong saw on the moon. As our commander, Brigadier General Robert McFarlin said after a November trip to our site, "there's no water, no trees, no electricity and plenty of sand..."

When we were first informed we were Saudi-bound, my first thoughts were that it couldn't be happening. But a few hours later, after much talking about our demise, it finally registered.

As packing duffle bags and processing for overseas movement became a daily job, the general's words echoed in my mind. Desolate. No comforts of home; no hot showers, no regular mail delivery — nothing except sand, rocks and wind. As I packed my bags, we were told there was no American Forces Radio (AFN) within range of our new home. Even at our home station in Stuttgart, Germany and in the U.S., I've never relied exclusively on U.S. network or AFN news reports. Shortwave has always been an addiction for me. I can handle lots of life's irritations, but being out of touch with world happenings isn't one of them.

Certainly my shoebox-sized communications receiver, a Kenwood R-1000, was ten times too large and heavy to take to Saudi. When you're squeezing that extra pair of socks into an already stuffed bag, size is a paramount concern. Every minute counted as I called Carolyn back in the States, asking her to order a small digital portable receiver. Frankly, I had always wanted a small portable, so I figured this was my chance. In the back of my mind, I was really hoping our alert to go would be cancelled. That way I'd simply have a new radio and unpack my bags.

finally, on the day before we deployed, it arrived. In less time than it takes to tune Radio Canada, I slapped in four "AA" batteries and packed it away. Now it was clearly 'Saudi duty time.' Immediately, everyone, from the soldiers manning the bunkers to the general, had this hunger for news about the Gulf crisis. There was no AFN, no mail and certainly no *Stars & Stripes* newspaper. Evenings, I'd sit on my cot listening to the VOA, BBC, Radio Canada, Radio Israel and many other international stations. Within a couple of days, as the command heard about someone actually hearing news reports, my boss, Public Affairs Officer, Major Rick Scott, asked me to keep listening to the shortwave, and compile a handwritten daily News Summary. His intention was to provide the latest news at the morning briefing. So, while everyone else was trying in vain to hear AFN, I was listening to the news from its source and writing a summary of the news for all of the 2nd Corps Support Command soldiers. From up-to-the-minute haggling over dates for peace talks to the progress of the war, the world was mine in a small plastic box.

Within a week, with increasing demand for the news summary, it now had to be typewritten and photocopied for major subordinate commanders to give to their soldiers. Checking major shortwave publications and relying on memory for frequencies and times, made listening a snap. Even after we moved to another location; this time within range of a small AFN station, the need for the news summary never diminished. It seems there was still this growing need to hear the latest news from unfiltered sources. So, once again, my shortwave listening hobby has benefited more people than my close friends. In our sleep tent, the "cowpokes," as we called ourselves; a close group of soldiers from the command staff judge advocate, chaplain, personnel and public affairs office, would gather around the radio for the latest news and views from around the world. It reminded me of pictures I've seen of families 'watching' the radio years ago — before there was television, but there was always shortwave. As we listened, most of us were probably listening for the best news of all, that the war was finally over, and we'd be going back home to our families and friends. ❐

From up-to-the-minute haggling over dates for peace talks to the progress of the war, the world was mine in a small plastic box.

Industry, *Cont'd from page 36*

airline, the benefits of extending satcoms into the cockpit could be even more significant. Indeed, it is the inadequacies of the present system that prompted the development of aeronautical satcoms systems.

Besides voice, Inmarsat's satcoms system also permits low- and high-rate data communications and these services are already available commercially through several GESs.

U OF T Engineering Students Take Science Workshops Into Elementary Schools

University of Toronto engineering students will tour metro Toronto classrooms in May and June with Science Outreach, a program designed to encourage young people to explore science and engineering.

Science Outreach is a series of workshops, hands-on tasks and interactive demonstrations for students in grades five through eight. The program is run by five U of T engineering students with funding from a federal government Science Culture Grant.

"The two-hour workshops help show young people that science, engineering and university aren't as exclusive as they may think. In fact, many students find they have hidden talents in design and problem solving," says Derek Ung, director of Science Outreach.

Some activities include building tall free-standing structures using only paper and tape, testing aerodynamic principles by assembling and flying circular paper airplanes and witnessing the effects of liquid nitrogen on plants.

The Science Outreach program visited 57 classrooms last year and was so popular that Ung expects to visit about 180 classrooms this spring.

The faculty of applied science and engineering will also run a summer science camp at the U of T. The camp consists of a series of five-day sessions during which groups of 20 participants will tour laboratories and take part in research and building projects. For example, young people will learn about colour chemistry by making paint and decorating their own high-tech fibre lab coats.

More than 275 students are expected to attend the summer camp, twice as many as last year.

NCR Awards Research Fellowship to University of Waterloo

NCR CANADA has announced it has awarded its newly-created Microelectronics Research Fellowship Award to Professor Savvas G. Chamberlain of the University of Waterloo's Electrical and Computer Engineering department.

"Valued at $48,000 per year for the next four years, the NCR award will be used to conduct fundamental research in the area of amorphous silicon-based technology as it applies to contact image sensors," says Bill Tait, general manager of NCR's Engineering &

Manufacturing (E & M) Division in Waterloo, Ontario.

Amorphous silicon devices — where silicon atoms are randomly packaged — are ultimately more cost-effective than the more common highly-structured crystalline silicon.

During the next four years, Dr. Chamberlain will investigate the use of amorphous silicon solid-state image sensors which are fundamental to document scanners, such as those produced at NCR's E & M facility.

"Very recently, NCR Waterloo expanded its mandate to include the development and manufacture of NCR's image-based products," adds Tait.

Amorphous Silicon is currently used in the LCD displays of laptop, portable and notebook computers. However, these silicon devices, with their random atomic structure, work much more slowly than their crystalline counterparts.

"One of the research challenges I, and my team, will be faced with will be maximizing speed while retaining the cost-benefits of amorphous silicon," explains Chamberlain.

His group plans to develop simulation tools to analyze and experiment with various implementations by using a computer before fabricating an actual device.

NCR Waterloo began operations in 1972 as a research,

development and manufacturing facility. Currently it is the world's largest facility dedicated to item processing and is a leader in the production and development of financial proof and encode equipment. It exports 95 per cent of its products to over 100 countries worldwide.

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CAL's Microgravity Furnace Reaches New Heights

Ottawa, ONT — March 1991 — CAL Corporation recently completed a series of successful microgravity tests using their Float-Zone Furnace aboard NASA's KC-135 jet aircraft.

The microgravity tests were a joint project of CAL Corporation and the Canadian Space Agency to study the differences in crystal growth using ground-based systems, and systems operating in near-zero gravity.

CAL's Float-Zone Furnace is designed and developed to examine the use of high intensity heating to purify materials in zero gravity. "In my opinion, the float-zone experiment is very well designed and promises to yield important scientific results, particularly if it eventually flies in space", says Marc Garneau, Canadian Astronaut and Payload Specialist.

CAL's unique furnace is semi-automatic, has a specially-shaped radiant heater, and uses ultrasonics for monitoring size and shape of the melt zone, or float zone. NASA has already shown considerable interest in CAL's furnace, as it is ideally suited for space-based float-zone studies, over other equipment available on the market today.

David Wilmut, and Marc Garneau, Canada's only astronaut to have flown in space, prepared and performed the microgravity experiments aboard NASA's aircraft. A pencil-wide rod of the semiconductor material, Germanium, was heated to its melting point of 937 degrees Celsius under both microgravity and hypergravity (about 2G) conditions. The Float-zone Furnace exceeded performance expectations under the relatively harsh conditions encountered during the aircraft's roller-coaster-like flight pattern. Analysis of the effects of the melt in

microgravity on the Germanium material is ongoing.

The Float-Zone is just one part of CAL's continuing involvement in space systems. CAL Corporation is an Ottawa-based diversified company specializing in space instruments and antennas, electro-optical instruments, microgravity research, search and rescue satellite terminals, and mobile satellite terminals for worldwide communications.

NSERC, Bell Canada Fund Industrial Research Chair

The Natural Sciences and Engineering Research Council (NSERC) and Bell Canada will fund the establishment of an industrial research chair devoted to studying electromagnetic interference and compatibility at the University of Toronto's department of electrical engineering.

Support for the initial five years of the $2.9 million research and graduate training program will be split three ways with NSERC contributing $1.01 million, Bell Canada contributing $800,000 in cash and $200,000 in human resources and the University of Toronto providing the balance.

"With the increasing speeds and complexity of communication and control technologies, electromagnetic compatibility is becoming essential to increase system reliability. Advances in the field of electromagnetics impact directly on the development of reliable telecommunications around the world," says Pierre Chagnon, vice-president of Bell Canada's engineering and research division.

"It is imperative that Canada pay greater attention to training new engineers in these and other advanced technologies," says Gilles Julien, NSERC executive vice-president. NSERC is Canada's largest research granting agency.

The establishment of the industrial research chair marks a high point in seven years of research collaboration between Bell Canada and U of T. "This exemplifies a mutually beneficial research partnership that can bring industry and the University closer together," says Gary Heinke, dean of the faculty of applied science and engineering.

The senior chair will be held by Professor Keith G. Balmain of U of T's electrical engineering department. Balmain has been conducting research on electromagnetic interference and compatibility for over eight years and has been active in antenna research and space science for over 30 years.

NASA To Feature Space Station Freedom at Paris Air Show

The Space Station Freedom will highlight the NASA exhibit at the 39th Paris Air Show, Le Bourget, France, June 13-23. The centrepiece of the 7,000 sq. ft. exhibit will be a full scale mock-up of a Space Station Freedom module.

Visitors will enter a module that combines the space station's habitat and laboratory facilities into one. They will view the crew quarters, the personal hygiene and exercise facilities and the galley. In the laboratory portion, there will be a furnace facility, protein crystal growth facility, modular containerless processing, life support system "salad machine" and gas grain simulation facility on display.

Japan, Canada and the European Space Agency are partners with NASA in Space Station Freedom.

Other NASA programs featured in the exhibit are Mission to Planet Earth and aeronautics research. The NASA exhibit also will commemorate 30 years of manned U.S. space flight with a large mural at the exhibit's entrance.

On June 14, NASA Administrator Richard H. Truly will hold a press briefing in the U.S. Pavilion. On June 17, Astronaut Daniel C. Brandenstein, Chief, Astronaut Office and Commander of the first Endeavor Space Shuttle mission, will meet the press.

NASA has been a major participant at the Paris Air Show since the mid-1960s. ❐

Ham, *Cont'd from page 35*

to protect others in our hobby from these crooks. Ask plenty of questions and see if they would mind you forwarding the model serial numbers for a police check. It helps keep thefts down on all equipment this way.

Al's story is a little different. He used the CARF manual to study at home and wrote the exam on his own. They scheduled him a month earlier than he wanted but he went ahead anyway. He was hoping to write in December as a Christmas present to himself. It came a month early. Two months home study and he was there. Not bad. Al does not yet have his HF privileges. He has a BASIC certificate but has been studying the code and should be ready to advance himself shortly. In the mean, he operates a used YASU 2500R which he bought for $300. He did buy a 5/8 whip antenna for $70 new. He has purchased a great variety of used equipment totally some $1500 but which would have been well over $7000 new. He is going first class and when he finishes the code tests will be on the air to Europe and beyond!!!

Al and Mark are the type of operators and fresh blood we need in this hobby. They are polite, courteous and ready to learn. Here are two new friends I would never have known if it weren't for this fascinating pastime. While you are considering if you would enjoy amateur radio or not think about Mar, Al and I. We talk to people around the world, phone home through our radio phone patches without the high cost of cellular and always have a carload of friends with us even when we a driving or boating alone! We're waiting to hear from you!

Next time I'll chat about protocol, clubs, on the air procedures and the Bluewater Corn Roast! Here is the address I promised:

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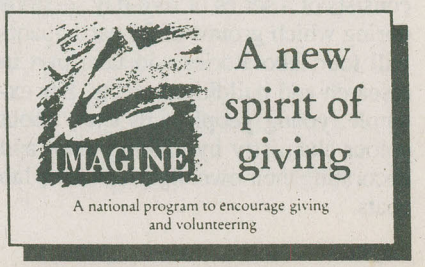

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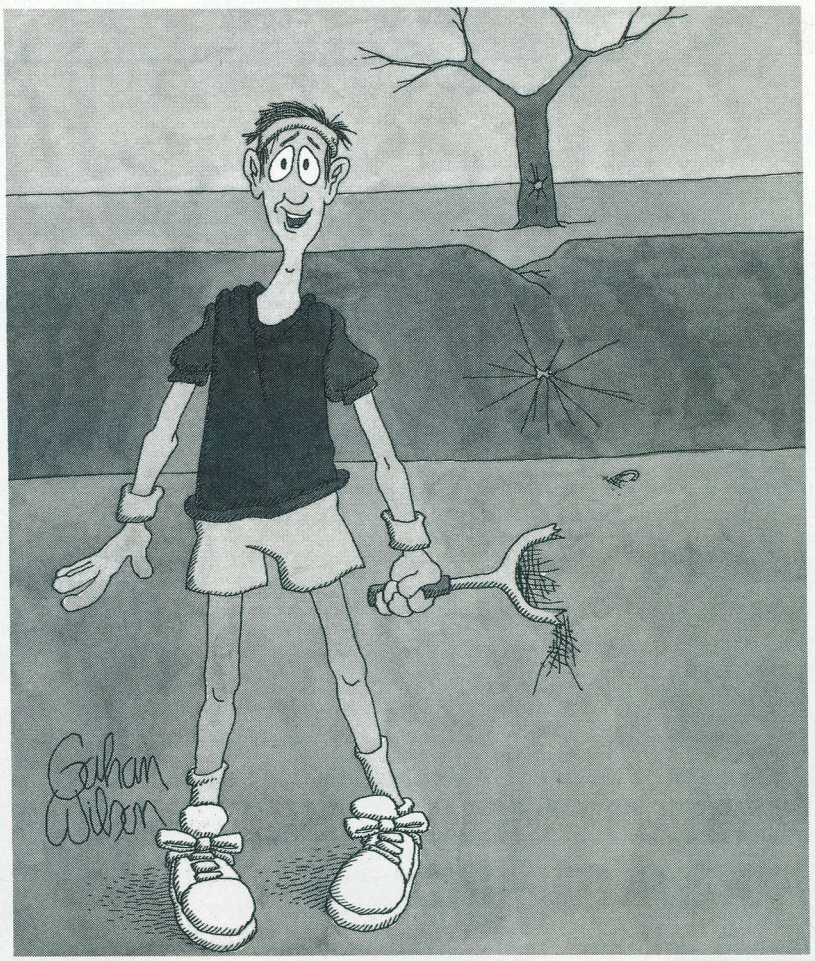

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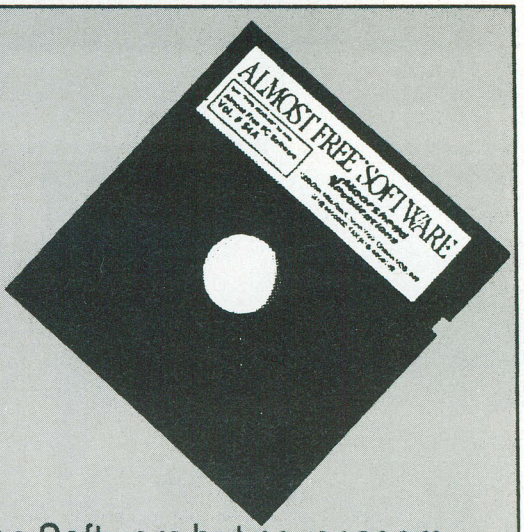

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